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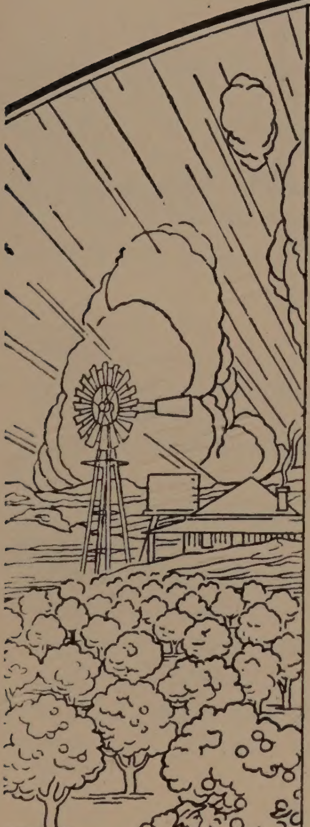
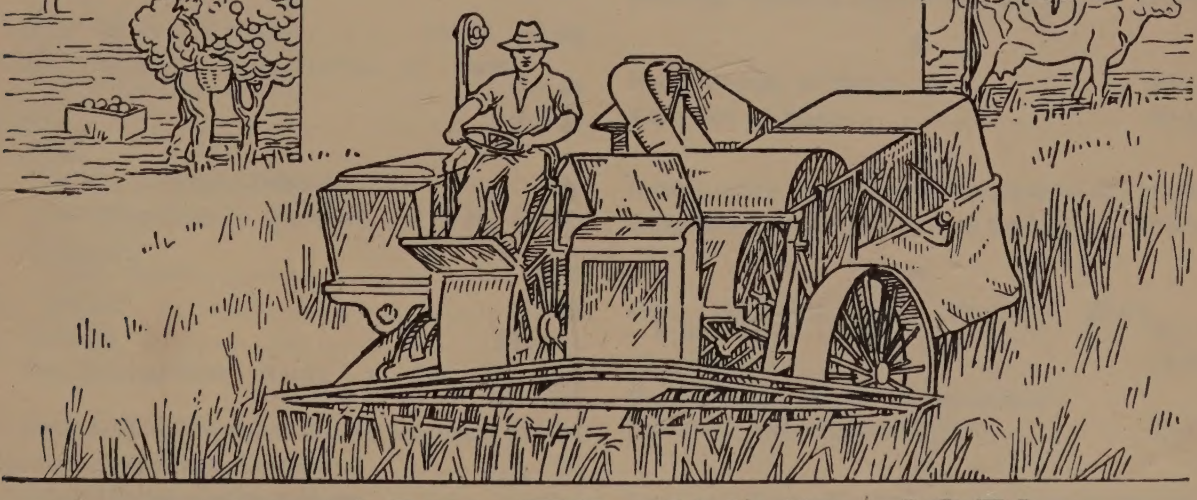


ISSUED BY DIRECTION OF

THE HONOURABLE
THE SECRETARY
FOR AGRICULTURE
AND STOCK

AUDAX AT FIDELIS

Edited by
C. W. WINDERS, B.Sc.Agr.



JANUARY TO JUNE, 1951.

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AUDAX AT FIDELIS

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Volume 72 Part 1

QUEENSLAND AGRICULTURAL JOURNAL

Edited by
C. W. WINDERS, B.Sc.Agr.

JANUARY, 1951

Issued by Direction of
THE HONOURABLE H. H. COLLINS
MINISTER FOR AGRICULTURE AND STOCK

GOVERNMENT PRINTER, BRISBANE

Contents

THE MINISTER'S NEW YEAR MESSAGE.

«»

The year just ended has provided the farmers and graziers of Queensland with a surfeit of rainfall rather than the deficiency with which they are all too familiar. The heavy rains have been a mixed blessing, and it is to be hoped that in all cases of hardship the long-term benefits will more than compensate for the losses which have been experienced.

Hon. H. H. Collins.

Droughts and floods are part and parcel of the primary industries of the State. The pioneers met these vicissitudes with courage and determination and laid the basis of the wealth of Queensland. The present generation, so much better equipped with material things and scientific knowledge, is in a much more favourable position to meet the fickle moods of Nature.

Flood mitigation is embodied in various dam schemes now under construction or contemplated by the Government. Drought risks likewise will be considerably reduced by water conservation schemes, but the individual landholder himself must in most cases accept the responsibility of feeding his stock in drought periods. I strongly urge stockowners to start at once to build up fodder reserves against the coming of the next dry period, which may not be far away.

A spirit of confidence in the future prevails in practically all the land industries. This faith appears to be fully justified, though current prices of some commodities may be expected to fall to somewhat lower levels. The appointment during the year of Royal Commissions to report on various phases of primary production is an earnest of the Government's desire to ensure planned expansion of major industries and the preservation of our natural resources.

I trust that the coming year will see increased production, adequate financial returns, and a continuation of those less tangible rewards of country life which the primary producer and his family are privileged to enjoy.

H. H. Collins

Minister for Agriculture and Stock.

Certificate in Agricultural Science.

ATTENTION is drawn to the certificate course in agricultural science now being conducted by the University of Queensland in collaboration with the Department of Public Instruction and the Department of Agriculture and Stock. It should be noted that the course is intended primarily for people who have been educated to Queensland Junior Public Examination standard or who have sufficient aptitude for study to enable them to assimilate something of the basic sciences.

Groundwork Studies.

As some knowledge of chemistry and physics is essential to the proper understanding of soils and plant and animal growth, an introductory course on the principles of these subjects must be taken by those who have not studied sufficient chemistry and physics previously.

The first year of the main course will be devoted to two subjects—the science of animal life, and the science of plant life. In the second year the science of soils and the growing of crops will be dealt with.

Specialisation.

After the first two years of the main course have been completed, the student can choose between livestock production and crop production for his specialisation in the final two years.

The livestock production course covers animal husbandry, stock breeds, pastures, and other aspects of the subject.

Those electing to study crop production can specialise in either field crops or horticultural crops. Subjects common to both groups include plant pests and diseases.

Requirements for Certificate.

Any of the subjects may be taken individually if the University agrees, but to secure a certificate, a full course in one of the special subdivisions must be completed.

Cost of Enrolment.

An enrolment fee of ten shillings is payable for each subject; the fee is paid as the subject is commenced. Certificate students may be required to attend a summer school of about a fortnight's duration each year at the Agricultural College at Gatton. The cost of board, etc., at the College should not exceed £5.

How to Apply.

Those interested in the course may obtain full particulars from the Supervisor, Brisbane Technical Correspondence School, G.P.O. Box 1389R, Brisbane. As the course commences in February, early application is desirable.

Soil Conservation in Queensland.

6. Pondage and Diversion Structures.

J. E. LADEWIG, Senior Soil Conservationist, and A. F. SKINNER, Soil Conservationist.

IN order to control erosion and to enable the efficient management of pastures it is often necessary to utilise pondage or diversion structures on pasture lands with the object of retaining the maximum amount of runoff for the benefit of the pasture and also to prevent it from entering vulnerable lower arable lands and causing accelerated erosion.

In many of the more severely eroded areas of the State a contributing factor has been the excessive concentration, on cultivation fields, of large volumes of runoff from overlying pasture lands. The overstocking and burning of many of these pastures has greatly increased the runoff; improved pasture management is a necessary step in the reduction of this erosion hazard. In a well-managed pasture paddock the protective influence of grass and more particularly the grass residues ensures the absorption of the maximum amount of rainfall and the risk of scouring is reduced. The reason for this lies in the fact that where a pasture is burned or overstocked the ground protection is removed and the soil surface seals readily; the infiltration rate is considerably reduced and runoff occurs with even minor falls of rain.

But even with the best conditions of pasture management, occasions do arise when runoff will occur, representing a loss to the pasture and an additional hazard to lower arable lands. This is the case where the soils become saturated during protracted rains and are incapable of immediate absorption of further rain. The stocking of pastures under conditions favouring soil packing may result in an increased runoff from areas which are otherwise well managed.

Provision should be made to temporarily pond this surplus runoff so that it can be absorbed later for the benefit of the pasturage; this also reduces the volume of water reaching lower arable lands and so lessens the risk of erosion. Two main types of pondage structures may be utilised for this purpose—namely, pasture furrows and pondage banks.

PASTURE FURROWS.

These are a series of level furrows constructed in pasture land and spaced so that they will pond a maximum amount of runoff, but with a minimum risk of overtopping. They are normally spaced 10 to 20 feet apart down the slope (Plate 1), each furrow ponding the runoff from the space between two furrows. It is essential that pasture furrowing operations commence at the crest of a catchment or, alternatively, immediately below a diversion or pondage bank.

Plate 1.

A Series of Pasture Furrows on Cultivation Land which is to be Retired to Pasture.

The spacing of pasture furrows is governed by a number of factors, including soil type, degree of slope, nature of cover and the implement to be used for construction. Furrows constructed with a single-furrow plough are usually of much lower capacity than those built with grader equipment and consequently a closer spacing is required in the former to reduce the catchment area above the furrow. Plough-built pasture furrows usually have a cross section of less than one square foot and in general the distance apart of these furrows should not exceed 10 feet. The capacity of grader-ditcher furrows (Plate 2) varies from 1 to 2 square feet cross section and provided reasonable plant cover exists they may be spaced up to 20 feet apart.

The closer spacing of furrows is required on steep slopes, on areas which have been overstocked or burnt, and on certain soil types such as the fine sandy loams where surface cementing of the soil readily occurs.

Apart from their soil conservation value, pasture furrows are often utilised solely for pasture improvement purposes; because of the additional water ponded in the furrows they are a satisfactory means of introducing into a pasture many legumes and grasses which might otherwise be difficult to establish. In this case the furrows should be spaced as closely as possible, consistent with economic considerations.

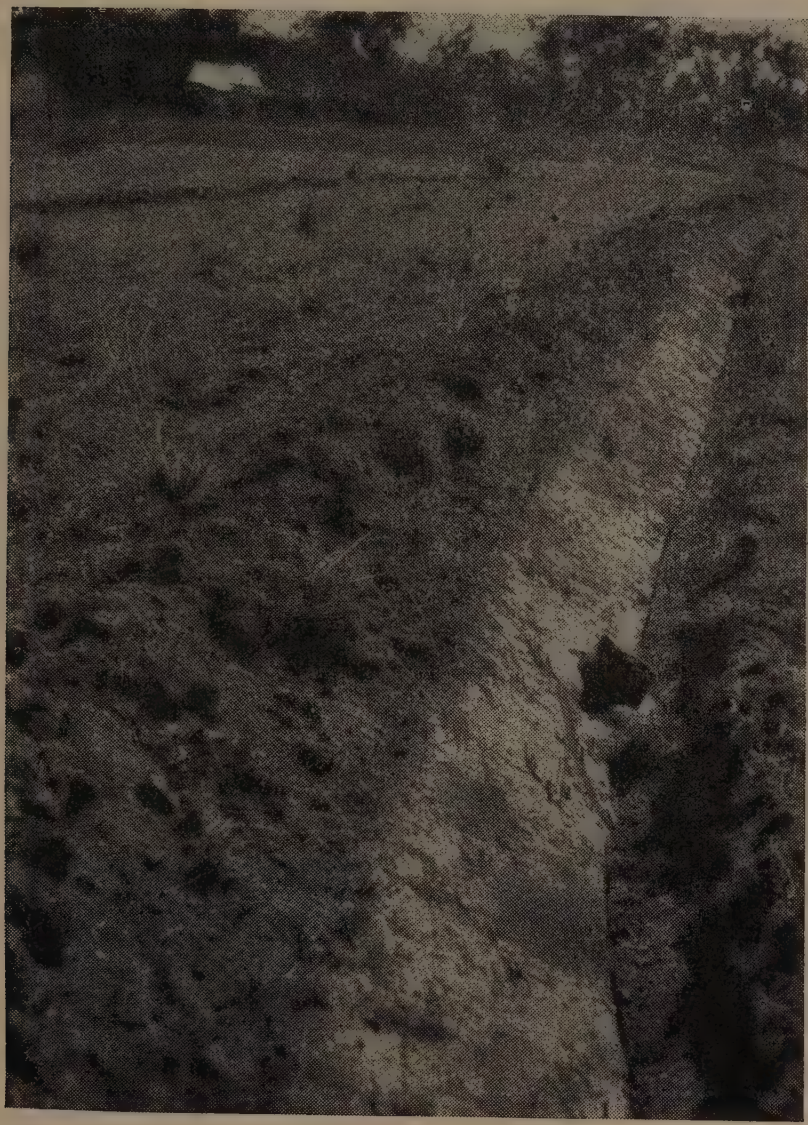


Plate 2.

A Pasture Furrow Constructed with a Grader-ditcher.

Pasture furrows are particularly useful for the regeneration of "scalded" pastures and claypan areas; because of the smooth sealed surface of scalded areas, water infiltration is slow and seeds readily blow away. Pasture furrows break the surface and facilitate the entry of rainfall and provide a receptive site for the lodgment of seed; they also reduce the ground velocity of wind, which is an important factor in areas subject to wind erosion.

Construction of Pasture Furrows.

These furrows can be effectively constructed with a very wide range of equipment, including the single-furrow road plough, multiple disc (Plate 3) or mouldboard ploughs, grader ditchers (Plate 4), and various other types of graders.

The soil is thrown downslope to increase the pondage capacity of the furrows and consequently two-way implements are an advantage for this work. Where one-way equipment such as the orthodox plough is used, it is necessary to carry out a non-productive return trip, which increases the cost of construction.

Plate 3.
Pasture Furrow Construction with a Three-disc Plough.

Plate 4.
A Modified Grader-ditcher being Utilised for the Construction of Pasture Furrows.

Grader-ditchers with a low centre of gravity are the most suitable as they are stable on steep slopes and, since the blade can be turned, they can be used continuously in throwing soil downslope.

The cost of construction of pasture furrows varies according to the nature of the terrain, spacing of the furrows and type of implement used. Where equipment specially designed for the work is utilised, the cost of construction even with an 8-foot spacing may not exceed 8s. per acre. With improvised machinery the cost is higher, but rarely exceeds 10s. per acre.

PONDAGE BANKS.

These are large level banks 3 to 5 feet high and with a water storage capacity of from 5 to 10 cubic yards per yard of length (Plates 5-7). They are designed to pond the maximum amount of runoff, but provision is made for overflow at one or both ends to avoid overtopping in the event of protracted rains; for this reason weirs are provided at the ends and are slightly lower than the top of the bank, enabling the maximum amount of pondage without risk of overtopping.

Plate 5.
A Level Pondage Bank Constructed in Pasture Land to Hold Surplus Runoff.

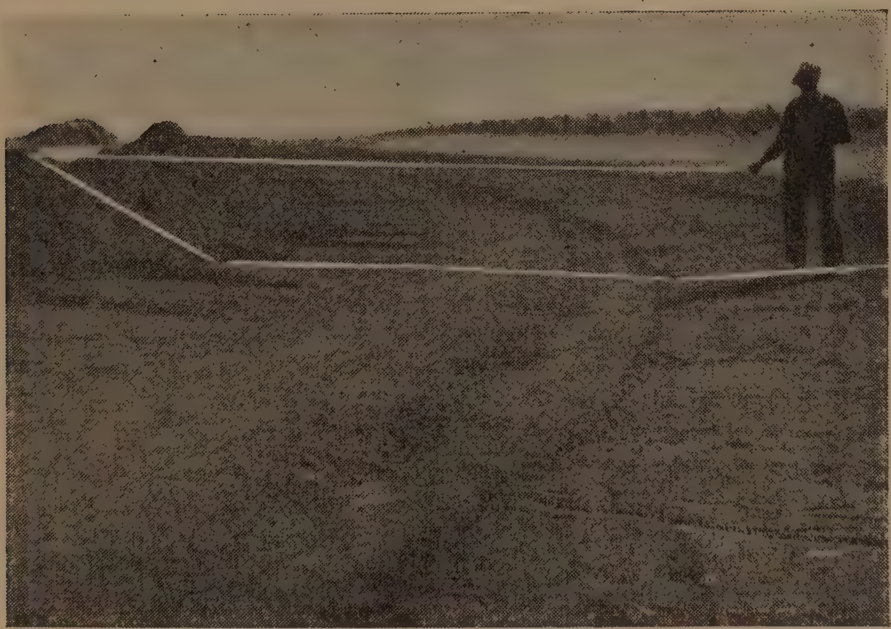


Plate 6.
A Completed Pondage Bank Built with a Farm Dozer.

Plate 7.

Pondage Bank holding back Water off the Cultivation Land Below.

The purpose of these banks is to pond the major portion of storm rains, which generally cause severe erosion damage, and if necessary, to flow the later part of the storm, which is usually of lower intensity.

The earth weirs at the end of these banks should be broad and level along the top and are usually 18 inches lower than the crest of the bank; if correctly tapered to ground level and well covered with vegetation, they are a very stable outlet through which water is transferred to a grassed waterway or spread on pasture.

The chief advantage of these pondage structures is that they can be constructed at any point in a pasture catchment and need not be situated at the crest of a slope, as is the case with pasture furrows. They are therefore particularly useful in steep or rocky areas where pasture furrows cannot be constructed right to the top of the slope.

Pondage banks function virtually as large pasture furrows but with the main disadvantage that the irrigation value of the stored water is restricted to the area in the vicinity of the banks; since they are usually spaced many chains apart the water distribution is not as satisfactory as with pasture furrows, which are rarely more than 20 feet apart.

Because of the extent of earth moving involved, pondage banks are usually constructed with a bulldozer; dozer units fitted to farm tractors are proving very useful for this purpose and are almost as efficient as the larger units (Plate 8).

The surveying of a level or true contour line is the first requirement for the construction work; a strip 25 feet is then ploughed as deeply as possible above this line. A dozer unit operating at right angles to the line, by a series of shuttle movements will excavate a channel about 20 feet wide above the line, and the soil is deposited below the line to form a bank 3 to 5 feet high and 15 feet wide at the base.

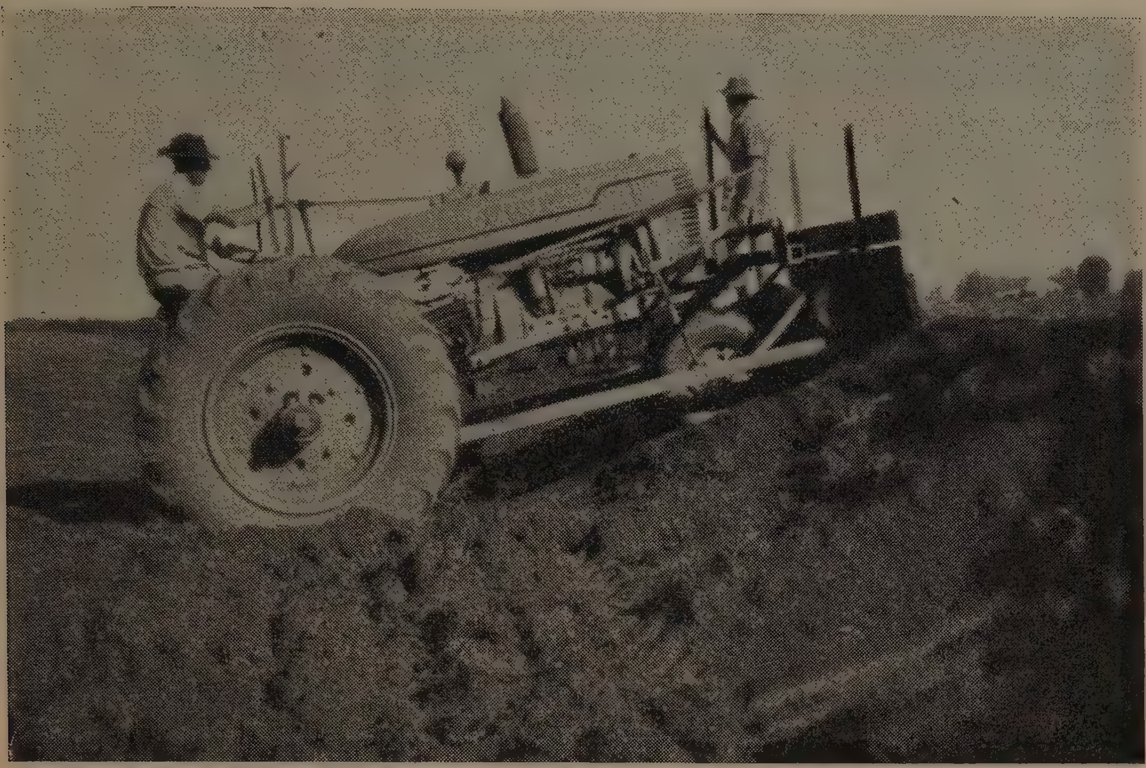


Plate 8.

Pondage Bank being Constructed with a Farm Dozer.

When construction is complete the crest of the bank is checked closely for errors in height and low spots built up. After the final level of the bank crest has been determined, an earth weir is pushed up at one or both ends, and is levelled at a point 18 inches lower than the bank height. The weir is then sloped down to ground level so that it will have a long steady gradient. Kikuyu or couch grass sod is then planted in the sill and covered with a thin layer of mulch, which is held in place with a cover of wire netting. This ensures protection of the weir while the grass is being established.

The cost of construction of these banks rarely exceeds 20s. per chain of length; a small bank will pond 100 cubic yards of water per chain, so the cost of 3d. per cubic yard of water held is a very reasonable expenditure for the benefits conferred.

DIVERSION BANKS.

Circumstances occasionally arise where it is not practicable to utilise pasture furrows or pondage banks because of the hazards associated with their use where major water flows are involved. A type of bank which will safely divert large volumes of water to a stable outlet is required in these cases.

These structures, known as diversion banks (Plate 9), are always designed with a gradient towards the outlet end; a grass cover is usually established in the channel and consequently a greater tolerance in channel gradients is permissible. A fall of 6 inches per 100 feet is usual, but in special cases where the soil type is suitable and very large flows are involved, the gradient may be increased to a maximum of 2 feet per 100 feet.

The size of bank varies according to the expected runoff, and for large catchments they are frequently built up to 4 feet high with a base width of 10 to 15 feet; the channel bottom should be flat with a width of 5 to 15 feet, depending on the size of the catchment area.

Plate 9.

A Typical Diversion Bank Protecting Lower Arable Lands.

Because these banks carry large flows of water it is most essential that they discharge on to a well-stabilised outlet or waterway; a vegetated disposal site must be available before the construction of a diversion bank is contemplated.

The method of construction will vary according to the type of bank required. Small banks may be constructed either with ploughs or graders, but large banks can be most economically constructed with dozer units by the method advocated for pondage bank construction.

An important difference between the construction of diversion banks and contour banks is that in the former the soil is moved entirely from the upper site, resulting in a lower cost of construction per unit of flow capacity.

RADIO TALKS TO FARMERS
(Australian Broadcasting Commission)
4QR AND REGIONAL STATIONS
THE COUNTRY HOUR—Daily from 12 noon to 1 p.m.
4QG AND REGIONAL STATIONS
COUNTRY NEWS MAGAZINE—Every Sunday at 9 a.m.

Control of Lantana by Cultural Methods in the Mackay District.

N. E. GOODCHILD, Senior Adviser in Agriculture.

ORIGINALLY lantana was introduced into Queensland as a flowering shrub for the garden. However, environmental conditions with high rainfall and humidity proved admirably suited to its propagation and it spread rapidly, particularly throughout the coastal belt of Queensland, where in many areas it is now regarded as a major pest.

In the Mackay district, lantana has become a problem in two separate areas—namely, on the Eungella Range and in the coastal fringes. Two distinct methods of control have been used in the district —destruction by mechanical means, and control by grass establishment and burning.

CONTROL BY MECHANICAL MEANS.

The Eungella Range is situated approximately 50 miles west of Mackay and has the most concentrated area of dairy farms in the Mackay district. The southern end of the Range is portion of the Connors Range, which joins the Clarke Range in the vicinity of the township of Dalrymple Heights.

The area consists of a rather narrow rain forest belt averaging five miles wide by forty miles long. Its altitude ranges between 2,000 and 3,000 feet above sea level. Its rainfall is approximately 80 inches per annum.

The country generally is broken and varies from undulating to steeply sloping land with deep gullies. The soils are mainly of granitic origin, varying from chocolate to yellow clay, but there are limited areas of red volcanic soil.

Areas overgrown with lantana on the Eungella Range are fortunately limited. Lantana apparently became established on clearings of the early settlement in the Bee Creek district and spread to other farms opened up along the Diggings Road, which later became heavily infested. As the settlement further developed in the Dalrymple Heights area, lantana extended along the roads, but farms were kept comparatively free of lantana by hand work.

Further penetration and wider distribution of lantana was brought about by timber getters opening tracks through the scrub, thus providing clearings in which the lantana became established.

The more recently settled areas of Broken River and Crediton have not experienced dense lantana infestation, due to care in eradicating the pest in its early growth. It is nevertheless a potential weed pest in this area.

In the past, lantana has been cleared by brushing and grubbing, but this method has proved both slow and costly and has not been satisfactory in controlling spread of lantana. Farmers have therefore experimented with mechanical means of clearing by utilising bulldozers which are located in the district for making access roads into the rain forest for pulling out logs for timber. It has been shown that these crawler-type tractors are capable of negotiating the lantana infested slopes on the settled area.

Where the slopes are not too precipitous it has been found possible to clear dense lantana on a face, pushing it into windrows in readiness for burning off. On steep slopes where heavy growth of lantana exists, clearing has been effected by the bulldozer proceeding up a spur with the blade raised and operating only on the downhill sweep. This entails considerable loss of time but is essential for the successful operation of the machine on difficult country.

Time of Clearing.

The most appropriate time for clearing has been found to be when the ground is wet. Under these conditions, the blade of the bulldozer cuts the stems of lantana cleanly below ground level, and the debris is then pushed into windrows or into nearby gullies for burning, leaving the land quite free of rubbish.

When conditions are dry and the soil hard, the bulldozer does not work efficiently. It tends to ride over the top of lantana bushes, stripping the stems and leaves and leaving the butts in the ground without cutting the roots below the surface of the ground. Under such conditions the land is covered with debris, while the butts left in the ground must be grubbed out by hand to prevent regrowth.

Cost of Clearing by Bulldozer.

Mechanical clearing of lantana is a costly undertaking and suitable only for dense growth. The use of the bulldozer on scattered growth would not justify the loss of time involved when the machine was not effectively in use. Before becoming involved in considerable expenditure, careful consideration should therefore be given to the use to which such clearing is to be put and the value of the land when cleared.

The cost of hiring a bulldozer varies according to the locality. The hire charge at Eungella was £3 per hour in 1948-49 (including the cost of its operator) for actual working time. All stoppage time was deducted, including lunch periods. The actual cost of clearing dense lantana, when conditions allowed treatment on a face, was approximately £5 per acre.

It can be readily understood, however, that the efficiency and experience of the operator can have an important bearing on the cost of the clearing.

Treatment of Land after Clearing.

It is essential that cleared areas be grassed down as soon as possible after clearing to check weed growth which may develop rapidly.

Pastures and crops which were tried at Eungella included kikuyu grass, white clover, Rhodes grass, prairie grass and oats.

Kikuyu grass seed is not available commercially and it is therefore necessary to propagate this grass by cuttings or rooted pieces. It should be planted from runners and roots which are not broken into small tufts but left in generous sized clumps and should be spaced approximately 6 feet by 6 feet, thus requiring 1,200 clumps per acre. If weather conditions are suitable, a complete ground cover can be expected in six to eight months.

Planting may be carried out by opening holes with a light axe, which when driven into the soil is prised sideways to provide a hole suitable for the rooted pieces or clumps. A light hoe or mattock can be used for the same purpose.

Planting material is carried in a bag strapped around the waist and dropped at appropriate intervals; after planting, the soil is consolidated by foot around the runners or roots. The cost of planting kikuyu grass in this way was approximately £2 per acre at Eungella in 1948-49.

It has been found at Eungella that when kikuyu grass establishes and maintains a complete ground cover, lantana is no longer a serious pest.

White clover, broadcast at the rate of 1-2 lb. per acre, will establish readily under reasonably good conditions in this area. The clover population will increase under proper management once good initial establishment has been obtained.

In one instance at Eungella, Rhodes grass and prairie grass, each sown at 2 lb. per acre, and oats planted at ½ bushel per acre, gave early grazing while the kikuyu grass was completing its cover. In this way valuable winter grazing was obtained.

CONTROL OF DENSE LANTANA BY GUINEA GRASSES.

Considerable areas of scrub occur along the main coastal range and have been felled and converted to pasture lands for dairying. Invariably lantana encroachment takes place and unless the weed is eradicated during its early growth it becomes a major pest.

This may be accelerated by heavy stocking, a practice often forced on farmers during the early development of dairy lands. The result is that pastures are denuded and insufficient cover is available to hold lantana in check; where burning off is not practicable, lantana growth has free and unrestricted scope for development.

Heaviest infestations in coastal parts of the Mackay district occurred on the dairy lands along the O'Connell River and East Funnell Creek areas, originally carrying dense rain forest. These areas were opened for settlement in 1931-33 and lantana became established quickly following the felling of the scrub.

Plate 10.
Guinea Grass Seedlings Growing in the Shade of Green Lantana.

Plate 11.
Young Guinea Grass among Dead Lantana following a Burn.

Plate 12.

Prolific Growth of Guinea Grass in Dead Lantana after a Burn.

The original grasses sown in the newly-cleared scrub land were those used in southern scrub areas—namely, Rhodes grass and paspalum. These grasses did not thrive as they do in the sub-tropical areas and fires were not sufficiently fierce to control the vigorous growth of lantana. The usual method of grubbing had proved too slow and costly in controlling the pest and it appeared as if lantana might completely ruin good farm lands in these areas.

To combat the vigorous growth of lantana it was essential to introduce strongly growing, bulky grasses, such as the Guinea grasses (*Panicum maximum*), which can not only compete with the growth of lantana but also provide a heavy body of grass for firing at the appropriate time; furthermore these grasses possess the ability to recover well after burning.

Guinea grass has given excellent results in controlling the spread of and in eradicating lantana on the O'Connell River and East Funnell Creek dairy lands.

A mixture of 2 lb. of common Guinea and 2 lb. of green panic grass (*Panicum maximum* var. *trichoglume*) planted during the wet season (January, February and March) will produce a complete cover and will set seed before winter. This seed will remain dormant until the following wet season.

An interesting feature of Guinea grasses is that they will thrive under shaded conditions of growing lantana and will germinate on old deteriorated pastures on scrub lands. If the grasses are planted on the top of a ridge, seed quickly washes down under lantana bushes, and when grass growth is sufficiently thick, firing can take place.

During its early stages of growth, Guinea grass is readily pulled up by stock and grazing at this period could considerably reduce the stand of grass. Grazing should therefore not be attempted until the growth of grass has reached a height of two or three feet.

The cost of Guinea grass (common Guinea) is approximately 4s. per lb. Green panic seed can be obtained at present at approximately 5s. per lb. The total cost of seed would thus be approximately 18s. per acre. As sowing the grass seed can be done for approximately 3s. per acre, the cost per acre of establishing these grasses would be approximately £1 1s. per acre.

It is expected that increased carrying capacity and increased production of dairy products so urgently required at the present time will follow the reclamation of lantana-infested dairy lands in these areas.

CONCLUSIONS.

Where country on the Eungella Range, heavily infested with lantana, can be cleared mechanically, regrowth can be effectively stopped by the establishment of a good cover of kikuyu grass.

On the lower coastal areas of Mackay, lantana growth can be eradicated and further spread can be prevented by planting Guinea grasses. The grass should be left unstocked and allowed to seed during the first year, and then fired at an appropriate time. The regrowth of grass, and firing as required thereafter, will eliminate lantana.

CHANGE OF ADDRESS.

Journal subscribers notifying change of address should state their full Christian names and surname as well as their full former and new addresses.

Address all communications to the Under Secretary, Department of Agriculture and Stock, Brisbane.

Lawrence—A New Wheat Variety.

D. ROSSER, Assistant Plant Breeder.

THE wheat-growing industry of Queensland owes much to plant breeding by the Department of Agriculture and Stock for the production of high yielding, drought-resistant and rust-resistant wheats of good grain quality. The breeding and testing of new wheats has been carried on and expanded since the retirement in 1948 of Mr. R. E. Soutter, who previously played such an important part in the development of new varieties. It is confidently hoped that future years will see further releases of improved varieties to assist the expansion of the industry in Queensland.

The hybrid wheat selection, Florence x College 3813, more familiarly known to growers as "Flo-Col," has now been registered as a new variety and named Lawrence. It has already been grown commercially on the Darling Downs for some years, and can be recommended where there is a demand for a highly-rust-resistant wheat which is palatable and capable of useful grain yields after grazing.

History of the Variety.

Lawrence was developed by officers of the Department of Agriculture and Stock from a cross made by Mr. R. E. Soutter at Kincora in 1932. The parents were Florence and a variety designated "College." The latter was almost certainly the North American variety, Hope, which is used as a source of rust resistance. In 1938, Lawrence was selected from the progeny of this cross for further testing and seed was released to growers six years later.

Characteristics of the Variety.

Lawrence is a slow-maturing variety with narrow blue-green leaves and a spreading habit of growth somewhat resembling Ford in the early stages of development. It tillers freely and produces a good bulk of foliage which is resistant to frost injury.

In the mature plant, the straw is moderately tall and creamy white. It is fine and hollow in structure, but fairly strong in resistance to lodging. The ears are beardless, small to medium sized, tapering and slightly curved in shape. The chaff is smooth and creamy white in colour; while the lemmas carry only short tip-awns usually less than $\frac{1}{4}$ inch long. The heads thresh readily, but there is normally no loss of grain in a standing crop.

The grain is of medium size with fairly smooth bran. It is amber coloured, semi-vitreous in texture, and produces a flour of very satisfactory baking quality.

Rust Resistance.

In possessing a large degree of resistance to rust, Lawrence is superior to other slow-growing varieties available in Queensland. This resistance applies to both stem and leaf rusts in the field. As yet, stem rust does not attack this variety severely and rust pustules are confined largely to a small area immediately above the lower nodes. In other cases, there is a darkening of the internodes. This suggests that the resistance was derived from Hope, in which such a discolouration occurs also.

Yield of Grain.

Although the variety is somewhat less drought-resistant than most of the quick maturing varieties grown in Queensland, it is capable of

useful yields of grain under good conditions. The following results have been obtained with Lawrence and other slow-maturing varieties in yield trials on the Darling Downs:—

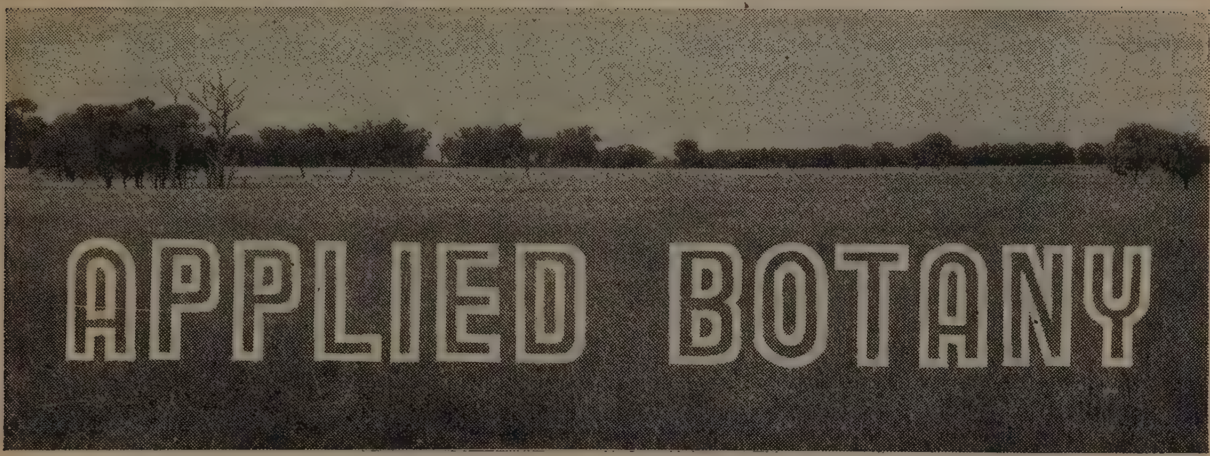
YIELD IN BUSHELS PER ACRE.

Variety.	1948.	1949.	1949.
Lawrence ..	44·1	39·5	9·7
Ford	44·6	27·4	12·6
Warput ..	41·9	34·3	13·7
	No rust	Medium rust	Heavily grazed in dry season

Utilization.

Lawrence is rust resistant, palatable and more cold resistant than most Queensland varieties; so it is suitable for early sowing and feeding off. It is recommended (i.) as a dual-purpose wheat to replace Ford and Warput in early plantings, and (ii.) as a hay or grazing wheat in mixed farming districts. Planted main-season, it is capable of useful yields, but cannot be expected in most seasons to compete with the quicker growing standard varieties in grain production.

Plate 13.
Heads of Lawrence Wheat (natural size).



Hoary Cress—Declared a Noxious Weed.

S. L. EVERIST, Botanist.

HOARY cress (*Lepidium draba*), a serious weed of wheatfields in many parts of the world, has recently been declared a noxious weed throughout the State. This note is issued to enable those interested to recognise the plant so that it may be destroyed wherever it makes its appearance.

Description.

Hoary cress is a perennial with an intricate system of underground roots which may penetrate to a depth of six feet or more. The roots spread horizontally and vertically through the soil and at frequent intervals give rise to shoots. The first shoots through the ground bear a rosette of leaves at the base; they are spoon-shaped, blunt at the tip and tapered at the base to a slender stalk; they are greyish-green, somewhat resemble cabbage leaves in colour and are of similar, though somewhat thinner, texture. The flowering shoots are upright and grow to a height of 12 to 18 inches; they bear scattered leaves which have no stalks but are attached to the stems by a broad base. In colour and texture they are similar to the rosette leaves, $1\frac{1}{2}$ to 3 inches long and $\frac{1}{2}$ to 1 inch wide. At the top of the stalks are borne dense clusters of small white flowers; these are followed by seed pods about $\frac{1}{8}$th inch across and divided into two compartments, each compartment containing one seed, egg-shaped, dark brown to purplish in colour and with a dull surface.

Distribution.

The plant is native to Europe and western Asia. It is a serious weed of wheatlands in England and North America and in the southern States of Australia. In Queensland it has been reported from several places on the Darling Downs.

Properties.

It has been reported that hoary cress is not eaten readily by stock, but if it is eaten by dairy cows it will taint milk.

Plate 14.

Portion of a Hoary Cress Plant. Note the stout whitish root, the stalkless leaves, and the clusters of white flowers.

Eradication.

Because of the extensive system of underground roots, eradication is not easy. Recent work has shown that the plant can be killed by spraying with hormone weedkillers at the rate of 2 lb. active ingredient per acre. Several applications may be needed to destroy the plant completely.

When a knapsack spray pump is used, the spray should be made up at a strength of 0·2 per cent. and applied at the rate of 100 gallons per acre. With boom sprays the strength of the solution should be adjusted according to the amount of liquid per acre delivered by the machine.

The method of making a 0·2 per cent. solution depends upon the amount of active ingredient in the original preparation. With a liquid preparation containing 10 per cent. active ingredient, use 1 gallon to 50 gallons water; with a 50 per cent. solution use 1 gallon to 250 gallons water; with powders use 1 lb. to 40 gallons if the preparation contains 80 per cent. active ingredient, 1 lb. to 35 gallons if the powder contains 70 per cent. active ingredient, and so on. The material should be applied with a fine spray and care should be taken to wet the leaves thoroughly.

INOCULATION OF LEGUME SEEDS.

★ ★

The Department of Agriculture and Stock supplies cultures of bacteria for the inoculation of seeds of legumes such as Poona pea, blue lupins, lucerne and clovers.

Seed inoculation is often necessary where the legume intended for planting has not previously been grown successfully, as it provides the plants with bacteria which are necessary for their full development.

Cultures are supplied free and post free. They are in bottles and have to be mixed with skim milk for sprinkling on the seed.

Order from the Under Secretary, Department of Agriculture and Stock, Brisbane, at least 10 days before sowing. State amount and type of seed to be treated.

Maroochy Experiment Station.

K. M. WARD, Senior Horticulturist, and K. FISHER-WEBSTER, Manager, Maroochy Experiment Station.

THE Maroochy Experiment Station (see view on pages 30 and 31) is situated three miles from Nambour in the heart of the Near North Coast, which is the most important fruit district in Queensland. It comprises 113 acres of land on the foothills of the Blackall Range, and like most farms in the district possesses several soil types with variable aspects and marked differences in elevation. This makes it a suitable centre for investigating many types of fruit and vegetable crops. The more important of these are pineapple, banana, citrus, avocado, Macadamia nut, strawberry, French bean and ginger.

SCOPE AND FUNCTION.

The station was brought into being to facilitate the investigation of cultural problems in the tropical and sub-tropical fruits grown in southern Queensland. In the past, work of this kind had of necessity to be conducted on private farms, where its scope was usually limited to projects which involved no radical changes in accepted cultural practices, and in which the risk of crop loss and inconvenience to the farmer was small. The solution of some problems calls for the trial of new and sometimes unorthodox cultural methods, or of new varieties of fruit plants, over a long period in which high yields are not necessarily the main consideration. Such trials on private properties are fair to neither the farmer nor the experimentalist. Adequate attention cannot be given to the problems of an important and growing fruit industry unless continuity of research—very often on the same piece of land—can be assured. An experiment station is indispensable for this purpose, and that at Maroochy therefore fills an obvious need.

The station not only provides a venue for long-term investigations; it also serves as a training ground for the horticultural research and advisory staffs of the Department of Agriculture and Stock, a centre where junior officers can gain practical experience in crop production

as well as a grounding in the principles of horticulture. In addition, it is an institution where the practical application of experimental results can be effectively demonstrated to the farming community.

CLIMATE.

Climatic conditions at the station are more or less typical of those in the wetter parts of the Near North Coast. The mean annual rainfall is 72 inches and 54 per cent. of this falls in the period December to March. Under cyclonic influences, individual falls may be torrential in character, as for instance in July, 1950, when eight inches of rain fell in a period of three hours. Under such conditions, precautions must be taken to prevent soil erosion, particularly on the steeper slopes of the property, which are representative of much of the land in the district. Usually the late winter and spring are relatively dry and tree crops may suffer severely if irrigation facilities are not available.

Temperatures at the station are those normal to coastal areas in the sub-tropics. The January mean maximum temperature is 86·5 degrees; the July mean minimum 45 degrees. Frosts of 4 to 6 degrees sometimes occur in winter but they affect only the lower portions of the slopes and land flanking Coe's Creek, which runs round the northern end of the property. As a number of the perennial fruit crops grown at the station are susceptible to frost and the susceptibility of each differs, the planting programme is highly selective for topographical features such as elevation and aspect. These, of course, influence the severity of frosts and also the amount of exposure to cold southerly and westerly winds. They are therefore particularly important in such crops as the banana, which, though endemic to the tropics, are grown extensively in sub-tropical regions for economic reasons such as their proximity to fresh fruit markets. The warmth assured by a northerly aspect, for instance, has a marked bearing on the rate of plant growth and the length of the period to fruit maturity.

TOPOGRAPHY.

The Maroochy Experiment Station is bounded on the north by Coe's Creek. This creek normally contains running water the year round, but if little or no rain falls in winter and spring the flow may cease. In the wet season it spills over the adjacent alluvial flats. The alluvial flats which are least subject to floods formerly grew sugar cane, but are too cold for most of the perennial plantation fruits grown in the district. From these flats the land rises by easy slopes, intersected at intervals by gullies, to a relatively steep spur some 150 feet above the level of the creek, which in turn is about 60 feet above sea level. The northerly aspect of the spur looking down on Coe's Creek is the main cropping area at the present time. The land on the opposite or southern side of the spur, together with the northerly slope of a second spur running more or less parallel to the first, is so far undeveloped, though part of the area has been planted to exotic pine trees. Both spurs run upwards to a rocky mass in the south-western portion of the station. The two tributary creeks heading in this rocky mass divide the station into three parts as they run to their junction with Coe's Creek.

Though the property had been farmed for about 30 years before it was acquired for experiment station purposes in 1945, much of the land is still in its virgin state although the more valuable timber was felled long ago. Most of the area, however, carried forest timbers such

as blackbutt, bloodwood and tallow-wood, all of which are indicative of a reasonably fertile soil. Rain forest influences are, however, noticeable along the creeks and in the upper reaches of the gullies.

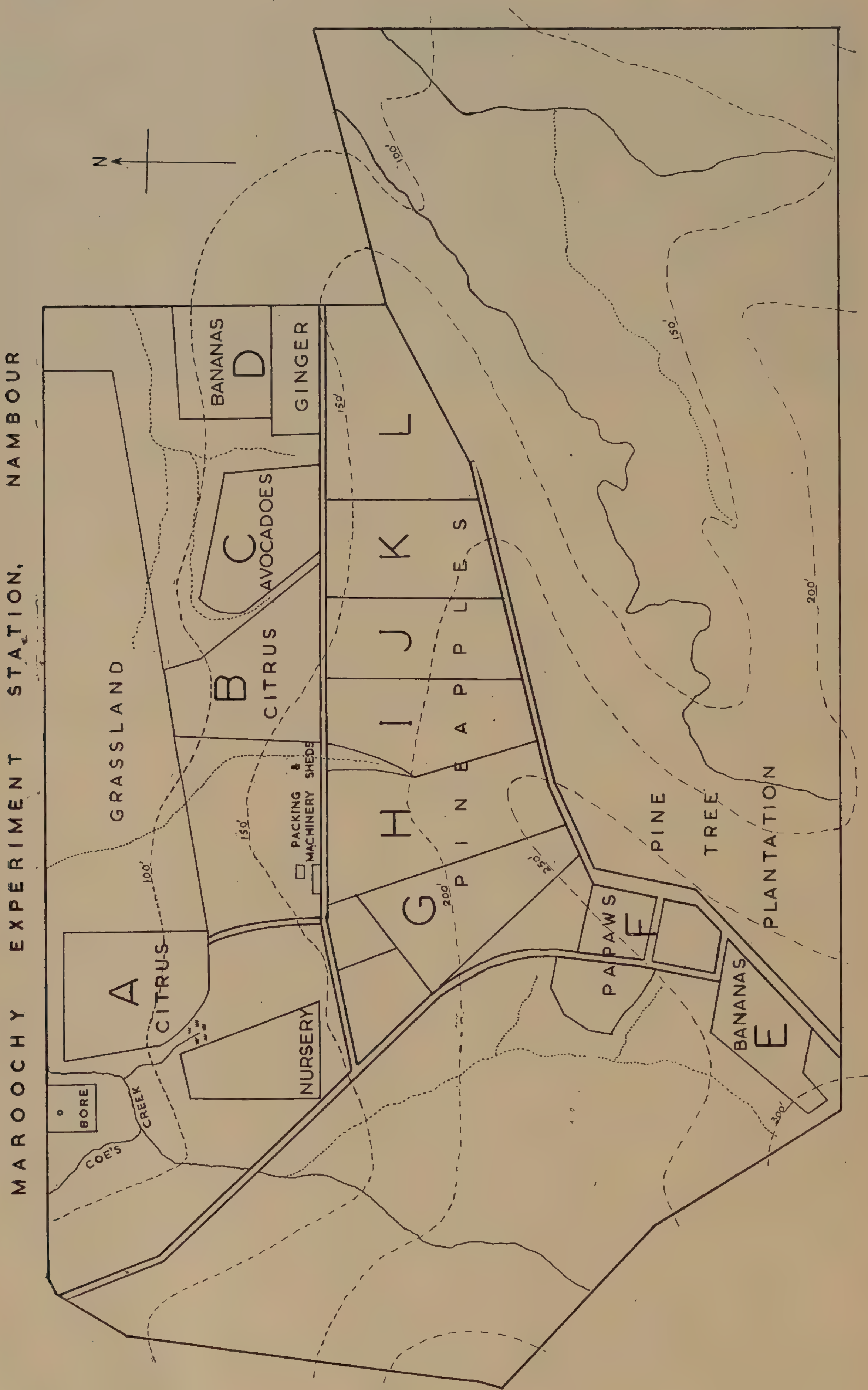


Plate 15.

Sketch Showing Layout of the Station.

SUBDIVISION AND RECORDS.

For experimental purposes, the area under crop is divided into blocks, designated A, B, C, etc., the size of which varies from one to two acres, the boundaries being determined by the position of gullies, the suitability of the area for cultural work, uniformity of soil type and aspect (Plate 15). Each block is further subdivided into borders, which are the units for experimental work and in which the cultural treatment is uniform. The borders are numbered so that any piece of land can be suitably designated—for example, B1, C3, and so on.

Station records are kept in the form of crop logs and border logs. The former give the complete history of experimental work carried out on particular crops, such as pineapples, since the inception of the station. Border logs on the other hand record for each border cultural practices, fertilizer applications and other treatments which might in any way affect the physical and chemical condition of the soil. Their importance lies in the fact that the behaviour of a crop can often be understood only in terms of the soil's earlier cultural history and management.

DEVELOPMENT.

The clearing and stumping of land was followed by the construction of access roads necessary for the efficient management of each block, and of surface drains for the control of runoff water. Roads which have already been constructed are shown in Plate 15. Some of these will eventually be surfaced to provide access in all weathers. Several areas now planted to tree crops, notably blocks A, B and portion of F, are permanently terraced as a soil conservation measure.

In the first five years of the station's existence, 24 acres of land have been brought under cultivation and an additional eight acres are planted with an exotic pine (*Pinus caribaea*) and flooded gum (*Eucalyptus saligna*). Fruit crop plantings are now as follows: Avocadoes, ½ acre; bananas, 2·7 acres; citrus, 4 acres; papaws, 2 acres; and pineapples, 7·5 acres.

Windbreak trees consisting of *Cupressus torulosa, Araucaria excelsa,* and *Pinus caribaea,* and ornamentals such as the jacaranda, Phoenix palms, flame tree and others, have also been planted where required.

Buildings erected for the storage of equipment and materials and for the handling of produce consist of a 72 feet x 18 feet machinery shed, suitably divided to house machinery and store fuel, fertilizers and tools, and a properly equipped packing shed 40 feet x 25 feet. The latter serves as a demonstration and lecture room when necessary. The station farm machinery, which is based on a 30 h.p. crawler-type tractor as the power unit, is adequate to cultivate hillsides as well as gentle slopes, to handle bulky green manure crops, to carry produce after harvesting, and to construct roads, drains, terraces and contour check banks. The provision of irrigation facilities has been initiated by the sinking of a 114-ft. bore which is expected to provide approximately 4,000 gallons of water per hour.

SOILS.

The soils of the station consist of several widely differing types (Plate 16), each of which fulfils the requirements of one or more of the horticultural crops grown in the district. It is possible, therefore, to plant each crop in a soil which is well suited to it. The soils are developed on sandstone and shales.

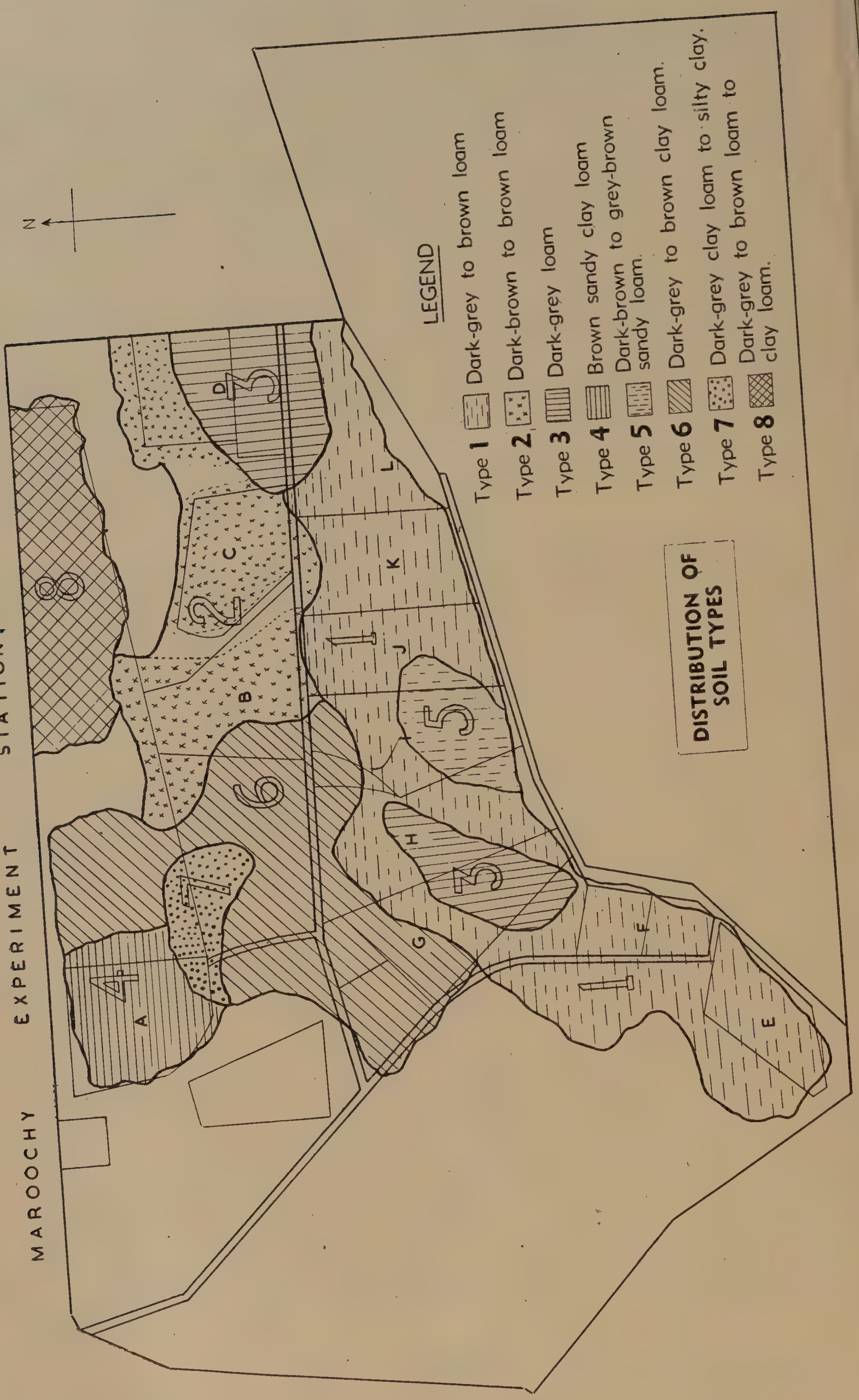


Plate 16.

Sketch Showing Distribution of Soil Types.

The main types distinguished in preliminary surveys are described below. Refer to Plates 17-21.

Type 1 (parts of blocks E, F, G, H, I, J, K) occurs on the greater portion of the main ridge and consists of a dark grey-brown loam. Two variants of the type are recognisable. One (Plate 17) is dark-grey in colour, possesses an excellent crumb structure, and has a clay loam subsoil at about 12 to 15 inches; the other is a grey-brown sandy loam, with a good crumb structure, but has less clay in the subsoil. The latter closely resembles the more important soils of the Nambour-Woombye-

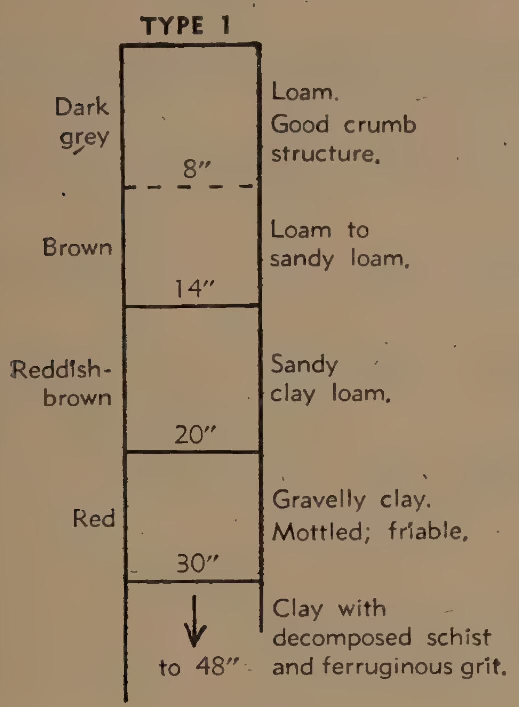


Plate 17.

Profile of Type 1.

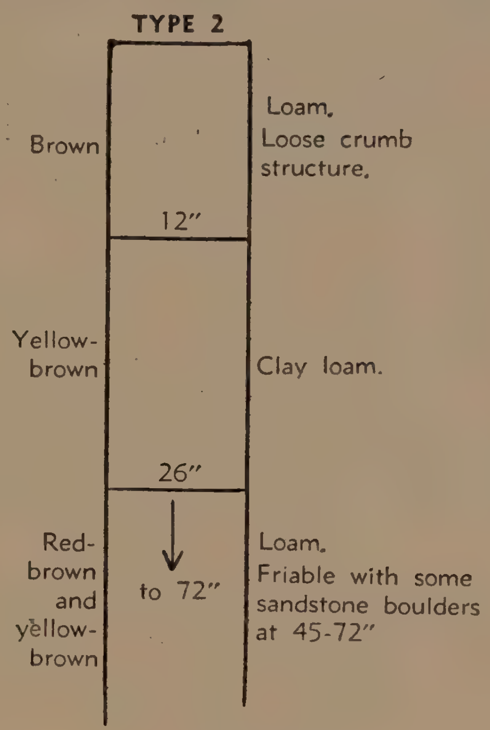


Plate 18.

Profile of Type 2.

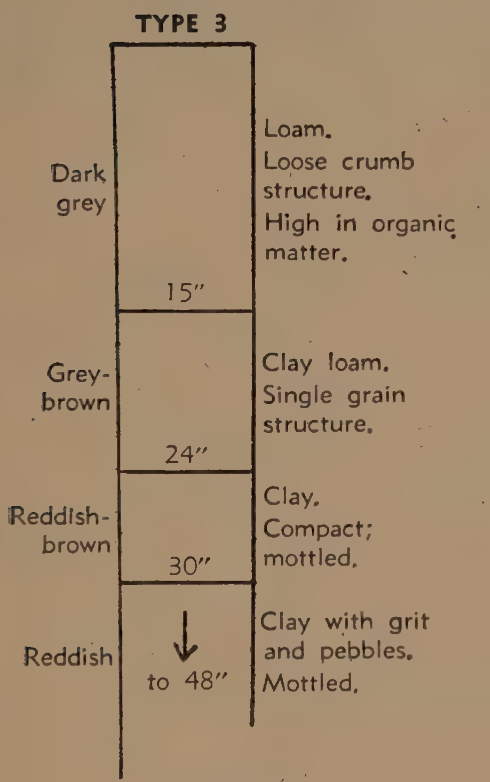


Plate 19.

Profile of Type 3.

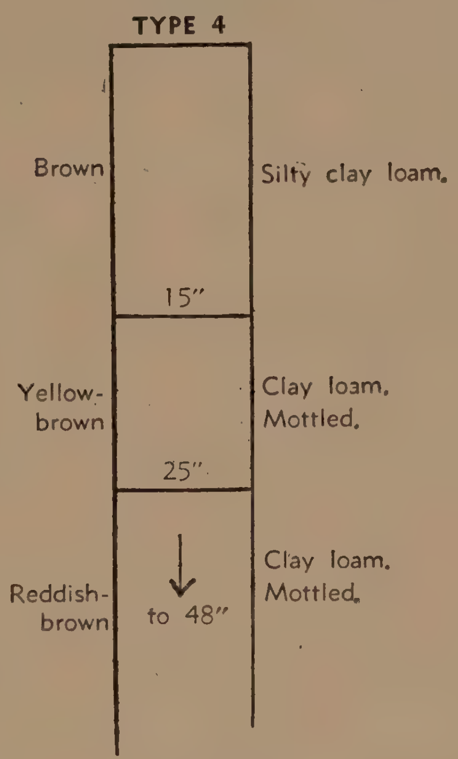


Plate 20.

Profile of Type 4.

Palmwoods area. The first of these two variants is devoted to bananas, papaws and pineapples; whilst the second is utilised solely for pineapples, for which it is primarily suitable. Chemical analyses have shown that the nitrogen, potash and carbon content are high, phosphoric acid is low, and pH value 5·8.

Type 2 (parts of blocks B, C, D) is a very deep, brown, friable and well drained loam with little clay in the subsoil (Plate 18). Physically it is one of the best soils on the station, and is very suitable for trees such as avocadoes and citrus which require good aeration in the root zone. In one area this soil type is relatively shallow, with a clay loam subsoil.

Type 3 (parts of blocks D, F, G, H) consists of dark-grey loam having a high organic matter content and an excellent crumb structure in the top six inches (Plate 19). The subsoil is a fairly porous clay loam. Where the depth of the surface layer is 12 to 15 inches this soil type is suitable for pineapples, but in areas where the subsoil is closer to the surface, it is better adapted to ginger and some small crops. It is above average in its nitrogen and potash content, but low in phosphoric acid; pH value is 5·4.

Type 4 (block A) occurs on a shallow ridge in the lower portion of the station. The surface soil consists of a fine sandy to silty clay loam of moderate depth (Plate 20). The area was originally strewn with numerous small boulders and stones. Because of its low-lying position and the consequent risk of frost, it is not suitable for tropical crops and has therefore been planted with citrus. Though not ideal for this crop, conditions have been improved by terracing the ridge and planting the trees in deep soil at the outer edge of each terrace. This soil is richer in phosphoric acid than any other soil type on the station, the potash supply is good and the carbon-nitrogen ratio is satisfactory; pH value is 5·9.

Type 5 (parts of blocks H, I, J) exists on a single small area near the top of the main ridge. It is a dark brown sandy loam, very friable to a depth of two feet, at which sandstone occurs (Plate 21). Excellent pineapples are grown on this area.

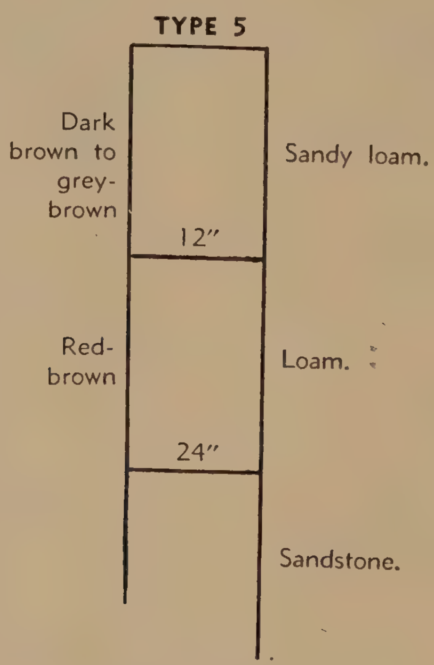


Plate 21.

Profile of Type 5.

Types 6, 7 and 8 are situated on low-lying sections of the farm. In most of these areas heavy clay occurs close to the surface, and the land is not likely to be used extensively for perennial fruit crops. A portion of type 6 may, however, prove suitable for Macadamia nut trees.

In the southern portion of the station, which as yet has not been brought under cultivation, there are two areas with aspects and soils which are suitable for tropical and sub-tropical fruit crops. The first of these lies in a small valley and the soil is a fine sandy loam of considerable depth, presumably deposited by the adjoining creek. It should grow excellent citrus and avocadoes. The second is a ridge rising on the southern side of the valley where the soil resembles the sandy loam variant of type 1; it is very well suited to pineapples and papaws.

The western portion of the property consists of rocky, timbered land suitable only for reafforestation.

INVESTIGATIONS.

The investigational work of the station is conducted under the supervision of technical officers each of whom specialises in a single crop or group of crops. These officers plan the investigations, and work in close collaboration with the station manager, who is responsible for all cultural operations and developmental work. Investigations undertaken to the present time are described in the following sections.

Pineapples.

The pineapple is the most important fruit crop grown in this region of the State and there is room for both an expansion of the area under crop and an increase in the productivity of existing plantations.

One long-term project at the station is concerned with the improvement of planting material by the systematic rogueing of off-types of low commercial value, and the production of new types capable of giving high yields of well shaped, good quality fruit (Plate 23). Mass selection has therefore been practised for some years on the station and the crops now grown are particularly uniform. Following the original selection made on commercial plantations, the first re-selection is made on the station in the plant crop, the land being broken up after the fruit from this crop is harvested, and all available planting material obtained; it is then planted to pigeon pea for twelve months, and subsequently replanted with selected tops. Operations are so arranged that one block of about two acres is planted each year. The mass selection programme is supplemented by clonal selection, which, though slower in producing results, should finally give a much more uniform and better accredited line of planting material than can be obtained by mass selection methods. An outcome of the selection work will be the release of limited quantities of high-class planting material to the industry.

A second long-term project has developed out of the urgent need for soil conservation measures on the relatively steep slopes often used for pineapple production on the north coast. Unless such erosion can be checked, it seems inevitable that many farms, including the station itself, will steadily deteriorate and become less and less productive. The better known and more generally applied soil conservation measures are not designed for hilly country on which cultivated crops are grown.

and the more simple modifications may not be suitable for the pineapple crop, which is very sensitive to excessive water round the root system. Something has to be done to conserve the soil on these slopes and experimental work is in hand to explore possible procedures.

With the several pineapple blocks reserved for plant selection, there is ample scope for short-term projects. Two which attracted attention were the demonstration that alpha naphthalene acetic acid effectively induces flowering in pineapples when applied in solution at a

View of Maroochy Experiment Station. Panorama lookin

concentration of 10 to 20 parts per million, and the experimental testing of sodium pentachlorphenate as a weedicide. Both projects have supplied information for advisory recommendations which were quickly incorporated in farm practice.

Block G—Plant Selection Block (2·75 *acres*).—Cleared in 1945 and planted in May, 1946, with selected tops from commercial plantations. Broken up in September, 1949, and planted with pigeon pea. Contoured in 1950 for planting in March, 1951.

Supplementary projects: Top rot and flower induction trials in 1948.

Block H—Plant Selection Block (1·75 *acres*).—Under a commercial crop of pineapples in 1945. Area extended in 1948, and the whole sown to pigeon pea in November of that year. Both the cover crop and the pineapples were broken up in 1949 and the area designed as a soil conservation project with the following treatments:—

(*a*) Drainage furrows lie between paired rows of pineapples planted on "contour" lines graded to 1 in 100, with check banks at 45 feet intervals;

(*b*) Drainage controlled by contour drain and check bank or bund, with pineapples planted directly up the slope; 45 feet intervals between check banks;

(*c*) Drainage by furrows situated at the rear of a bench terrace, with pineapples planted on the contour; minimum width of terrace—15 feet;

(*d*) Drainage by sectional drains with pineapples planted directly up the slope.

main spur under pineapples, with citrus blocks on lower slopes.

This block was planted with selected suckers and slips in 1949.

Block I.—Plant Selection Block (1·9 acres).—Cleared in 1946. Borders 1-3 planted in March, 1947, and Borders 4-5 in March, 1948, with selected tops. The whole area was broken up late in 1949, sown to Poona pea, and replanted with selected tops early in 1950.

Supplementary projects: Fruit maturity studies in 1948 and flower induction studies in 1949.

Block J—Miscellaneous Pineapple Investigations (1·75 *acres*).—Partly under commercial pineapples in 1945. Borders 3 and 4 assigned to a soil management trial with intercycle treatments such as the trashing of old pineapple plants and the growing of a green manure such as cowpea. These should demonstrate whether or not working organic matter into the soil before planting will lengthen the fruiting period of replant crops. Soil management trial planted with selected slips and suckers in 1948. Borders 1 and 2 cleared in 1948, cover cropped during the following summer and then planted with selected tops in March, 1949.

Supplementary projects: A weedicide trial in 1950 and a comparison of single and multiple tops as planting material in the same year.

Plate 23.
Portion of the Pineapple Plantation. Fruit is being covered with woodwool for protection against sunburn.

Block K—Plant Selection Block (2·2 *acres*).—Partly under commercial pineapples in 1945 which were broken up in 1946, then under pigeon pea until March, 1948, then planted with selected tops. This crop was disposed of early in 1950, and the block will be green cropped for twelve months. The balance of the area was cleared in 1948, cover cropped during the whole of the following year and then planted with selected tops in March, 1949.

Supplementary projects: A weedicide trial in 1949 and fruit maturity studies in 1950.

Bananas.

The banana has been an important developmental crop in Queensland for very many years. It was formerly grown on virgin ground from which the rain forest had been cleared, and production declined when suitable country of this kind became scarce in southern Queensland. The future of the industry depends largely on the ability of the grower to handle the crop on land which lacks the high fertility of virgin rain forest country. This involves not only correct soil management but also efficient control of bunching, particularly in the ratoon crops.

Work on the latter subject began at the Maroochy Experiment Station in 1949 with the planting of two acres of bananas in contour rows with the necessary provision for inter-row drainage. A grass mulch is applied in June each year to conserve soil moisture, and prevent erosion (Plate 24).

The main aim is to find a practical basis for selecting the suckers which form the ratoon crop. Information is therefore being sought on the correlation, if any, between the age of the parent when the sucker is set and the subsequent growth of the sucker; on the time of the year at which the sucker should be set; and on the relative merits of different types of sucker from which a selection can be made in the plantation. All have a particular significance in southern Queensland where both temperatures and rainfall are often far from the optimum requirements of the plant during winter and spring.

Block E—Banana Suckering and Spacing Block (2 *acres*).—Partly under commercial pineapples in 1945. Broken up in 1948 and the rest of the land cleared and stumped. Planted with bananas in 1949, partly at normal spacings and partly at wide spacings.

Block D—Banana Planting Material (1 *acre*).—This portion was cleared in 1947 and was green cropped until 1949, when a trial was initiated with Cavendish bananas to evaluate bits and suckers as planting material when planted in different ways.

Papaws.

The papaw industry has made rapid headway in Queensland but the future depends very largely on the practicability of placing high-quality fruit on the southern market in volume. One handicap is the lack of uniformity in the type of fruit grown at the present time. Commercial plantations are almost entirely established from seed which is far from pure owing to uncontrolled cross pollination. Every plant

Plate 24.

Experimental Cavendish Banana Block Showing Contour Planting, Drainage Furrow and Blady Grass Mulch.

therefore differs from others in the plantation in one or more characters such as the time of fruit maturity, thickness and colour of the flesh, size of fruit and yield potential. In these circumstances, it is difficult to produce the even-sized high-quality fruit which is required for both the fresh fruit market and canneries.

Plate 25.

Bettina Papaws Produced by Controlled Pollination.

The primary horticultural consideration in this crop is therefore the development of suitable varieties by selection and hybridization, their fixation by controlled pollination, and finally the production of pure seed in sufficient volume to meet growers' requirements (Plate 25). This involves a long-term breeding project, which has been in progress for some time. The work is now located at the Maroochy Experiment Station. Pure seed of the varieties Bettina and Improved Petersen was released from the station in 1949 but the available stocks have been insufficient to meet the demand.

Block F—Papaw Breeding Block (2·25 *acres*).—Under old bananas in 1945. Cleared in 1947 and regularly cover cropped until planted with papaws in 1948. One border is assigned to a lime level trial and the production of pure seed, a second to the production of hybrid strains, and a third to line selection.

Citrus.

Good trees are the foundation of a first class orchard and the production of such trees depends largely on the type of rootstock used and the quality of the buds worked onto it. In order to ensure that seed and budwood shall be the best obtainable, the Department of Agriculture and Stock supplies both to nurserymen each year. The seed and budwood come from parent trees which are true to type, in good health, and possess a consistent cropping record.

In the past, seed has been collected and budwood cut from privately owned orchards but this procedure is not altogether satisfactory. One difficulty arises from the fact that citrus trees should be specially pruned for budwood production and the methods used are quite different from those applied in normal orchard practice where the out-turn of fruit is the primary consideration. The Department has therefore decided to grow citrus trees on its own properties from which part of the budwood required can be cut.

Two orchards were established at the Maroochy Experiment Station in 1948 for this purpose. The plantings are designed not only to simplify the cutting of budwood, but also to give information on the behaviour of several varieties of citrus when grown on different rootstocks. The more important stocks are the rough lemon, which normally induces vigorous tree growth; sweet orange, which is associated with high quality fruit and long tree life; Emperor mandarin, which is particularly suited to mandarins; and Trifoliata, which may prove to be the best commercial stock in areas where the root disease, brown rot gummosis, is potentially dangerous.

Plate 26.

New Zealand Blue Lupin Green Crop being Mown in Citrus Block.

Block A—Citrus Budwood Block, No. 1 (1·75 *acres*).—Cleared in 1946 and cropped with green manures during that and the following year. Contour terraced in 1947 and planted in May with trees produced in the Station nursery.

Block B—Citrus Budwood Block, No. 2 (2·25 *acres*).—Cleared in July, 1947, and then cover cropped until contour terraced in July, 1948 and part planted two months later. Planting completed in 1949.

Routine maintenance in both blocks involves the use each year of cowpeas in summer and either New Zealand blue lupin or a rust resistant cereal in winter as a cover crop (Plate 26).

Avocadoes.

The avocado is a comparatively new fruit commercially in Queensland. Overseas experience, particularly in California, indicates that, once the public is assured of regular supplies of good quality fruit and has acquired an appreciation of its merits, the consumer demand should be very keen.

The fruit from seedling trees is variable and such trees cannot therefore form the basis of a worthwhile industry. The Department is interested in selecting suitable varieties for commercial production and then working out methods of propagation which will ensure that trees of the desired type can be made available to growers from well managed nurseries. Both are long term projects for which the Maroochy Experiment Station provides a suitable location. Three varieties, Fuerte, Nabal and Anaheim, which are at present recommended to growers as suitable for the Australian market, have been planted and the area will be gradually extended. The orchard should provide a convenient source of budwood and also prove a useful centre for observations on tree behaviour under north coast conditions.

Block C—Avocado Varietal Block (1·75 *acres*).—Cleared in 1946, cover cropped for the following three years, and then part-planted with avocadoes in 1949.

Plate 27.

Ginger Plants, Showing Rhizomes or "Roots."

Miscellaneous Crops.

Ginger.

The ginger industry is firmly established in the Nambour-Buderim area, where the crop is grown in close proximity to the processing factory which is located at Buderim. The crop is relatively new to the State and until recent years its cultural requirements were not well known, but investigations have assisted materially to elucidate these. Experimental work, which was transferred to the station in 1947, has reached the concluding stages, and firm recommendations on cultural methods are now available.

Block D—Ginger Experiments.—Portion of this area was cleared in 1946 and planted with ginger (Plate 27) in 1947; it has been under this crop for four years. In alternate years a ratoon crop is grown.

Green Crops.

Studies on the growth and behaviour of potentially useful green crops have formed the basis of the station's green cropping programme and recommendations to growers. An outstanding crop developed by the station for horticultural purposes is pigeon pea (*Cajanus cajan*), a perennial plant which is proving a most useful soil improver and conserver, particularly during periods between pineapple plantings. Short-term crops which provide ground cover during the wet period, and green manure for incorporation with the surface soil in autumn, are Poona pea and Black Mauritius velvet bean. Worthwhile winter crops are New Zealand blue lupin and Victoria x Richland oat. Miscellaneous perennial legumes from North Queensland tried under Nambour climatic conditions included Calopogonium, Stylosanthes and Centrosema, which were the most promising; though they made excellent growth during the summer they usually suffered from winter frosts.

GREEN CROPPING PROGRAMME.

Green cropping on the station is based on the principle that cultivated land must not be left bare, and accordingly the following schedules are adhered to:—

(1) A perennial legume, usually pigeon pea, is grown for a period of about 12 months between successive plantings of pineapples, papaws and bananas. The green crop is sown after the fruit crop has been trashed, and at maturity it is disced and ploughed in the course of land preparation for the next fruit planting.

(2) Summer and winter legumes and cereals are grown in orchard areas. Cowpeas are usually sown in October-November to provide ground cover in summer, and New Zealand blue lupins or oats in March-April for the winter crop. The cowpeas are disced in February or early March, and the winter crop is mown in September and later disced for the sowing of the summer crop. If at any time either of the two annual crops shows signs of competing with the trees for soil moisture, it is promptly mown.

(3) As each new piece of land is cleared it is customary to plant pigeon pea until the area is required for a horticultural crop.

CONCLUSION.

In its brief history of five years, Maroochy Experiment Station has initiated work which should lead to the solution of a variety of horticultural problems.

Directions in which the work seems likely to develop in the future are:—

(1) Improved soil management and soil conservation practices. This work will involve the use of surface mulches, and of green crops for soil coverage and green manure, contour planting and the practicability of terracing on sloping land.

(2) The production of high-class propagating material of pineapples, papaws and citrus.

(3) The propagation and culture of Macadamia nuts and avocadoes.

(4) The uses of various weedicides, both for preventing weed emergence and for destroying growing weeds, including grasses.

(5) The uses of substances which control growth and flowering of plants, particularly pineapples.

(6) Banana plantation management, particularly with reference to control of suckering and fruiting.

(7) The control of diseases and pests in various fruit crops.

Foot Rot and Foot Abscess of Sheep.

G. R. MOULE, Director of Sheep Husbandry.

FOOT rot and foot abscess are two diseases of sheep which are well known in the southern States of Australia, but which are comparatively unknown in Queensland. Even in districts where these diseases are prevalent they are not always differentiated, and any lameness of sheep, associated with painful or suppurating conditions of the hooves, is often regarded as being due to foot rot.

In Queensland, the majority of the sheep are to be found in the semi-arid pastoral country, where rainfall is low and poorly distributed. In addition, evaporation is high and the consequent aridity has been an important factor contributing to the freedom of Queensland flocks from foot rot or foot abscess. During the last two years, however, bounteous seasonal conditions have prevailed, and in southern Queensland quite heavy rains have fallen in the winter. In a good deal of the semi-arid pastoral country, which usually enjoys between 18 and 20 inches of rain each year, over 70 inches fell in 1949 and the first eight months of 1950. This was followed by further widespread and rather persistent rain in the spring. Foot rot and foot abscess occurred amongst some flocks in southern Queensland during the winter and spring of 1950, and the object of this article is to draw the attention of woolgrowers to the treatment and control of these diseases.

Neither condition is known to cause serious trouble in this State, though foot abscess was quite prevalent in a few flocks in the central-west following the wet conditions which prevailed in 1941 and the continuous winter rains of 1942.

Foot Rot.

Foot rot is a specific contagious disease caused by an organism referred to as the K organism. It is seasonal in nature and occurs mostly in wet periods.

The infective organisms are voided from the feet of "carrier" animals, which contaminate the pastures. The organism persists on the pasture for two weeks and on gaining entrance to the foot of an unaffected animal it causes inflammation of the skin between the two

hooves, especially in the vicinity of the heels. From there, it invades the deeper tissues and enters the sole, suppuration working forwards towards the toes. More than one hoof and more than one foot may be affected at once.

Animals suffering from foot rot are very lame, and when both front feet are affected at once the sheep may go down on its knees.

Suppuration of the skin, separation of the sole, and finally separation of the hard wall of the hoof are often part of the usual course which the disease runs. Small amounts of foetid, grey, dry, crumbly pus may be found between the separating layers of the sole or wall.

Sometimes concurrent infections with pus-forming organisms may set up abscesses around the coronet, and while these may run fairly rapid courses, true foot rot is essentially a chronic disease.

Foot Abscess.

Foot abscess is sometimes called digital suppuration. It also is a specific disease, caused by an organism known as *Fusiformis necrophorus*. This disease is seasonal in nature and occurs particularly in wet years. It may occur in one foot only, or even in one hoof of one foot, and up to 40 per cent. of a flock may be affected.

The causative organism enters through the fissures in the horn, particularly when they are cracked during a dry time, or through abrasions. Most commonly, infection occurs through the toe, although it may occur through chafed skin in the vicinity of the heels.

When infection does occur, an abscess, which is virtually encased in the foot, develops and the pus may break out at the coronet.

Acute lameness is usually the symptom first noticed. Detailed examination reveals that one claw is hot and inflamed and pressure causes pain. The imprisoned pus, which is thick and creamy, may break out at the coronet. If the condition remains untreated, serious consequences, such as sloughing of the back tendons, may occur.

Distinguishing Foot Infections.

The differential diagnosis between foot rot and foot abscess is made largely on the clinical appearance of the affected feet, although there are other points worthy of consideration. Foot abscess affects sheep of any age and a large proportion of a flock may suffer from the disease at one time. In addition only one hoof may be affected, whereas foot rot is more prevalent in younger sheep, more than one claw is affected, and it is unusual for such a large proportion of the flock to be affected.

Treatment of Affected Animals.

Animals suffering from either of these diseases should be isolated from the rest of the flock. Treatment is easily effected by trimming the sheeps' feet with secateurs or a sharp knife. All dead horn should be removed and pus exposed. Treated animals should then be made to walk through foot baths containing a 10 per cent. solution of copper sulphate (bluestone) every 2 or 3 days until they have recovered.

Sulphanilamide ointment (10 per cent.) is useful when applied to the feet of sheep suffering from foot abscess. Its use would probably be restricted to valuable stud animals.

Prevention.

Particular attention should be paid to the feet of stud sheep imported from States where foot rot is prevalent. Should an outbreak occur, it is advisable to examine the feet of all the sheep in a flock and isolate any showing abnormalities such as chafing at the heels or overgrown horn. These animals should not be returned to the flock until they have been normal for over one month.

After an outbreak of foot rot it is essential to spell the paddocks for at least one month, to make sure the infective organism dies out of the pasture before more sheep become affected.

TUBERCULOSIS-FREE CATTLE HERDS

(AS AT 15th DECEMBER, 1950).

Breed.	Owner's Name and Address of Stud.
Aberdeen Angus ..	The Scottish Australian Company Ltd., Texas Station, Texas
A.I.S.	F. B. Sullivan, "Fermanagh," Pittsworth
	D. Sullivan, "Bantry" Stud, Rossvale, *via* Pittsworth
	W. Henschell, "Yarranvale," Yarranlea
	Con. O'Sullivan, "Navillus Stud," Greenmount
	H. V. Littleton, "Wongalea Stud," Hillview, Crow's Nest
	J. Phillips and Sons, "Sunny View," Kingaroy
	Sullivan Bros., "Valera" Stud, Pittsworth
	Reushle Bros., "Reubydale" Stud, Ravensbourne
Ayrshire	L. Holmes, "Benbecula," Yarranlea
	J. N. Scott, "Auchen Eden," Camp Mountain
Friesian	C. H. Naumann, "Yarrabine Stud," Yarraman
	J. F. Dudley, "Pasadena," Maleny
Jersey	W. E. O. Meier, "Kingsford Stud," Rosevale, *via* Rosewood
	J. S. McCarthy, "Glen Erin Jersey Stud," Greenmount
	J. F. Lau, "Rosallen Jersey Stud," Goombungee
	G. Harley, Hopewell, Childers
	Toowoomba Mental Hospital, Willowburn
	Farm Home for Boys, Westbrook
	F. J. Cox and Sons, "Rosel" Stud, Crawford, Kingaroy Line
	R. J. Browne, Hill 60, Yangan
	P. J. L. Bygrave, "The Craigan Farm," Aspley

ANIMAL HEALTH

Salmonellosis of Chickens.

A. K. SUTHERLAND, G. C. SIMMONS and G. S. COTTEW, Animal Health Station, Yeerongpilly.

SALMONELLOSIS is a serious infectious disease that was first recorded in chickens in Queensland in 1946. Since then it has been diagnosed with increasing frequency, as shown in Table 1. It is therefore a relatively new disease in chickens, and often receives little or no mention in books on poultry diseases. In ducks and turkeys it occurs more frequently and has been well known for many years under such names as paratyphoid, infectious enteritis and ''keel'' disease. This article, however, deals with the disease in chickens only.

TABLE 1.

FREQUENCY OF PULLORUM DISEASE AND SALMONELLOSIS IN CHICKENS UNDER THREE WEEKS OF AGE EXAMINED AT ANIMAL HEALTH STATION.

Year.	Number of Batches Examined.	Pullorum Disease.	Salmonellosis.
1946	43	24	1
1947	37	13	3
1948	60	13	12
1949	41	2	5
1950 (to 31 October) ..	61	7	16

It can be seen from Table 1 that salmonellosis now ranks with pullorum disease as a cause of losses in chickens. Mortality in different outbreaks has varied from 10 per cent. to 90 per cent. but most often it has been between 25 per cent. and 50 per cent.

The Salmonella bacteria that cause disease in chickens can also infect man and other animals. Salmonellosis in human beings has been called food poisoning, gastro-enteritis or paratyphoid fever and it may be fatal, especially in babies.

Cause.

Salmonellosis is an infectious disease caused by bacteria called Salmonella. About 200 different types (or species) of Salmonella are known and all of them, except *Salmonella pullorum*, cause a similar disease in chickens. Pullorum disease, caused by *Salmonella pullorum*, has special features that distinguish it from salmonellosis so it is not considered in this article.

The salmonellae that infect chickens also quite often cause disease in ducks, turkeys, pigs, cattle, sheep, horses, dogs, rats and mice. In fact almost any Salmonella type can infect almost any animal or bird (wild or domesticated), or man. Thus, sick individuals or healthy carriers of any of these species of animals can be the source from which chickens contract salmonellosis.

Symptoms.

Salmonellosis can occur in birds of all ages, but is most common in chickens under three weeks of age. The symptoms are similar to those of pullorum disease. The affected chicks are dull and they seek warmth and chirp continuously. Some of them may show evidence of diarrhoea. Quite often chicks are found dead without having been noticed sick.

Post-mortem examination usually shows nothing that would enable one to make an accurate diagnosis. There may be congestion of the lungs, pneumonia, inflammation of the intestine or a general water-logging of the tissues, but similar lesions occur in other chick diseases.

Diagnosis.

The symptoms and lesions of salmonellosis are often indistinguishable from those of other chick ailments, such as pullorum disease, chilling and faulty brooding, so bacteriological examinations must be done to obtain a correct diagnosis. Several dead chicks, or preferably some dead and some live sick chicks, should be sent with full particulars to the Animal Health Station at Yeerongpilly or at Oonoonba. The specimens should be sent by rail or road transport to reach the laboratory without delay, otherwise they may arrive unfit for examination. If the specimens are dead they should be sent in a box or tin packed with dry wood-wool or sawdust.

The earliest that results of bacteriological examinations can be expected is 24 hours after the specimens are received, and complete examination requires several days.

Control of Outbreaks.

The three steps that have proved effective for controlling outbreaks of salmonellosis are:—

(1) Destroy all the sick chicks each day; if mortality has been heavy, it is better to destroy all the surviving chicks in the affected batch;

(2) Treat immediately with sulphamezathine or sulphamerazine in the drinking water; and

(3) Clean and disinfect the brooder house and the feed and water vessels.

Sulphamezathine and sulphamerazine are sold by poultry supply houses as 16 per cent. solutions, so two fluid ounces of solution per gallon of drinking water will give the recommended dosage, namely 0·2 per cent. of the drug. Treated water is given for four days and during this time no access to untreated water should be allowed. These drugs should not be administered for more than four days because they may produce harmful effects.

Treatment does not protect the chickens from re-infection, so hygienic measures must be taken to eliminate the Salmonella bacteria from the environment. The brooder house and the brooding equipment

should be thoroughly cleaned. The feed and water vessels should be washed clean in hot soapy water and then immersed for one hour in a disinfectant solution, such as 5 per cent. lysol.

A brooder that has been occupied by infected chickens should be cleaned and then left unoccupied for a month before it is used again for a fresh batch of chicks.

Vermin such as rats, mice and cockroaches should be controlled, because they can harbour and spread Salmonella bacteria.

All the surviving birds from an affected batch should be fattened and sold for slaughter as soon as possible. It is known that a proportion of these birds, called carriers, remain infected and excrete salmonellae in their droppings.

Prevention.

Salmonellae do not live and multiply outside the animal body, so the ultimate source of infection is always an infected bird or animal, either domesticated or wild. A proportion of the birds, or other animals, that have been exposed to salmonellosis remain carriers of the disease and excrete the organism in their faeces. Hens may harbour salmonellae in their ovaries and so may lay infected eggs. These carrier animals or birds appear normal and healthy and can be detected only by bacteriological examinations. Unfortunately, the blood test that is so efficient for detecting carriers of pullorum disease is not reliable for detecting Salmonella carriers.

It is evident that chickens can contract salmonellosis by ingesting or inhaling the excreta of carrier animals or birds, or, as in the case of pullorum disease, they may be infected in the incubator.

A high standard of hygiene in the brooder will protect chickens from contracting the disease through the ingestion of excreta. The feed and water vessels must be cleaned regularly, and fouling of the feed or water by the chickens themselves or by any other birds or animals must be avoided. Salmonella bacteria can multiply rapidly in water containing particles of fowl feed.

The brooder pen should be kept clean and dry. Salmonella bacteria are destroyed by dryness, but they can live for weeks in wet places, particularly if shaded from direct sunlight.

Chickens should be reared in isolation so that they have no contact with fowls or other animals, and attendants should avoid carrying infection into the brooder pen by means of dung on their boots.

Eggs produced by carrier hens may be infected in the ovary where they are formed or by contact with excreta when laid. In the latter case, the Salmonella bacteria penetrate the egg shell during incubation and infect the developing chick embryo. When the infected chick hatches, the organisms are rapidly spread through the machine so that the whole batch of chickens is exposed to infection. Formaldehyde fumigation 6 to 8 hours after the hatch is set should be used to destroy bacteria on the surface of the eggs. Fumigation must *not* be done between 24 and 84 hours after the eggs are set because it impairs fertility. Soiled eggs must not be used for hatching and a high standard of hygiene must be maintained throughout the hatchery.

Beef Cattle Production on Some of the Gulf Watersheds.

J. C. J. MAUNDER, Director of Veterinary Services.

PROBLEMS associated with beef cattle production in the area between the Mitchell and Gilbert Rivers, in the lower eastern portion of Cape York Peninsula, were the subject of enquiry by the writer during a visit to the area in September, 1949. The area reported upon here is situated west of longitude 144 degrees and between latitudes 15 and 18 degrees. It extends over the main portions of the basins of the Gilbert-Einasleigh, Staaten, and Mitchell-Walsh Rivers and includes marine plain country abutting on the Gulf of Carpentaria (Plate 28).

Only an incomplete survey was possible, and much of the matter presented is necessarily of a somewhat general nature, but the article will serve as a broad survey of the cattle-raising industry in this rather remote area.

VEGETATION AND WATER SUPPLIES.

The cattle country of the Gilbert, Einasleigh, Staaten and Mitchell Rivers consists of two main and very distinct types—the "frontage" (Plates 29-32) and the "forest" (Plates 33-35). Probably 80 per cent. of the cattle are run on the river frontages, and the greater the proportion of frontage to forest on a holding, the better the carrying capacity of the property.

Frontage.

The depth of frontage country varies considerably. On some holdings there is a good expanse of double frontage up to twenty miles wide; on others the frontage extends less than a mile from the main channel of the river; on still other places there is a good frontage on one side and practically none on the other.

Soils of the frontages are light-grey, structureless alluvial deposits of fine-textured silts and clays. Normally they are hard and compact, and when worked up they are loose and powdery. As well as being of poor physical condition, they appear to be fairly infertile and low in organic matter. There are no black soil plains similar to those in the country of the Gregory, Leichhardt and Flinders Rivers, with the exception of an area on Gamboola and Wrotham Park on the Mitchell River.

Usually the frontages carry a fair body of grass, but there are some "scalded" areas where the grass is thin or absent; these are described locally as "clay pans" or "scalded flats."

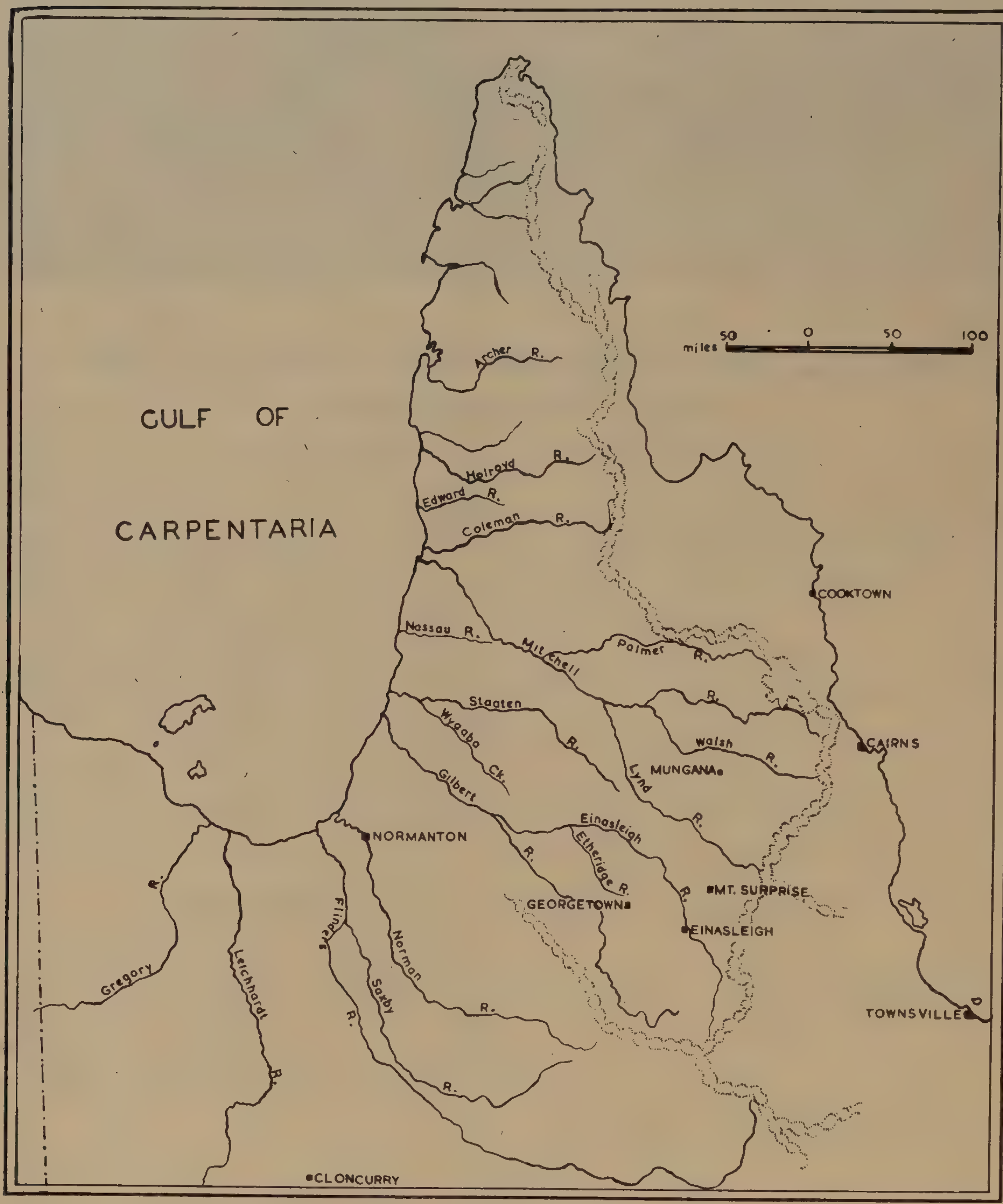


Plate 28.

Sketch Map of the Gulf and Peninsula Country.

The trees and the grass cover vary somewhat according to soil variations, but the dominant trees are a box and a bauhinia on the flats, with a tea-tree on the watercourses. The best grasses are a species of blue grass, Flinders grass, some false Mitchell grass on the better flats, and spear grasses. Fire grass is prevalent on the scalded flats; it is a slight and very inferior annual feed.

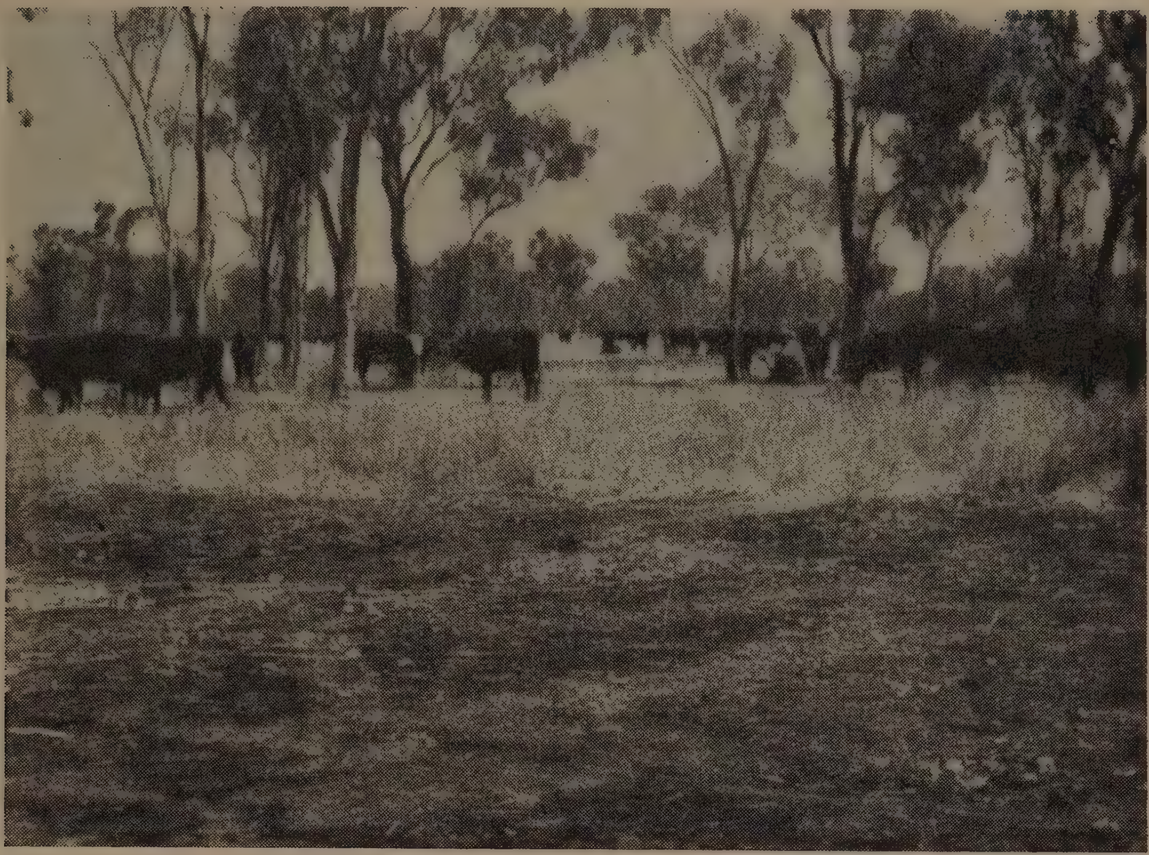


Plate 29.

Hereford Cattle on Frontage Country of the Gilbert.

Forest.

The forest country is very much inferior to the frontage country. It comprises the bulk of the areas between the Gilbert and the Einasleigh, the Gilbert and the Staaten, and the Staaten and the Mitchell, as well as the country immediately north of the Mitchell.

The forest country is flat and devoid of landmarks, of lower elevation than frontage country, and therefore more "boggy" and susceptible to flooding in the wet season than the frontages.

The soils are light-grey silt loams and loams, which are structureless and apparently of low fertility. The surface soil is shallow and overlies a heavy, impermeable clay. In wet seasons, the soil readily becomes waterlogged and boggy. Low ridges of sandy soil are interspersed with these flat, poorly-drained areas.

The grasses are in thin tussocks, with much bare space between, and carry practically no flag. It is all ant-hill country, and some of the colonies are 12 to 15 feet high. The trees consist mainly of broad-leaved tea-tree and "gutta percha." There are strips of wattle scrub and a sprinkling of beefwood, messmate, narrow-leaved tea-tree, plaited tea-tree, dogwood, and ironwood, with occasional bloodwood. The dominant vegetation type consists of tall lean grasses in scrubs of broad-leaved tea-tree and "gutta percha," freely ornamented with ant-hills.

The Staaten and Red Rivers and Wyaaba Creek have very little frontage country, the true forest coming practically to the banks.

Apparently, the value of the forest country lies in the fact that, on the lighter sandy strips, green shoots come away fairly quickly after storms and provide an earlier green pick than the frontages.

Water Supplies.

The water systems of the river basins under discussion are rather unusual. The main systems of the Mitchell-Walsh-Lynd-Palmer, the Staaten, and the Gilbert-Einasleigh-Etheridge head in the ranges of the Great Dividing Range or its spurs and flow in a general north-westerly direction to empty into the Gulf. A peculiar feature of the Mitchell and Gilbert systems is the formation of distributaries—creeks flow out from one river and empty into another, or back to the mother stream, or flow from a river and pursue individual courses direct to the sea. For example, Magnificent Creek flows out of the Mitchell and rejoins it near the mouth; the Scrutton River flows from the Mitchell into the Nassau, which itself comes from the Mitchell and empties into the Gulf. The Staaten, in comparison with the other two, is a very poor water system.

The combination of permanent "holes" in the rivers (Plate 36) and creeks with lagoons (Plate 37) and shallow swamps ensures good reliable water in both the forest and frontage country. Lagoons are situated in watercourses; some are permanent, but others are shallow and, like the swamps, dry up in August and September.

Generally speaking, all holdings are well supplied with surface water from these sources. One large place, however, is not so well served and has put down a number of bores equipped with mills and troughing. As a rule, bores are not very satisfactory in this area, which is outside the artesian basin. The permanent lagoons begin to thin out on the eastern fringe of the area, in the vicinity of the Walsh River, and artificial watering facilities such as wells have to be provided.

Cattle feed in the lagoons and swamps only while they contain water. There is no vigorous growth of fringing pasture, so once the water goes, the cattle feed elsewhere. This is contrary to the widely-held view that, in this country, cattle feed on a lush cover of grass as the waters gradually recede from the shallow banks of lagoons and swamps. In fact, although the lagoons carry a large and varied population of birds, the soil or water (or both) do not appear to be suited for the growth of good fringing pasture.

Coastal Country.

Impressions of this type of country (Plates 38-41) were obtained from observations on Rutland Plains and the Mitchell River Mission, which are said to be typical of the country from Delta Downs, through Macaroni, Galbraith, Rutland Plains, and Mitchell River Mission to Edward River and perhaps slightly north of the Edward. It extends inland from the coast for about 30 miles and therefore the scope is approximately 200 miles by 30 to 35 miles—that is, 6,000-7,000 square miles of country.

In this area there is no frontage and forest as described for the country further inland. The country has more the nature of downs and plain, freely broken by a network of watercourses and strips of lighter sandy ridges that are fairly heavily timbered and somewhat resemble "forest" country.

The plain country between the breaks of watercourses and timbered strips consists of grey loams and clay loams of moderate depth and apparently of fair fertility; they are tight and compact. It is sparsely timbered with a box and a bauhinia and carries a good body of feed

Plate 30.

Rank Pasture on the Banks of Walker's Creek, which Runs Out of the Gilbert. Similar pastures are found on the banks of many of the rivers and creeks.

Plate 31.

Bauhinia Flats on Frontage Country of the Gilbert. This is some of the best of the frontage country on which "short feed" retains fair nutritive value when dry.

similar to typical good frontage country. The lighter ridges are fairly heavily timbered with another species of box, various gums, ironwood, "pear," "plum," and a sprinkling of pandanus. The feed here consists of a fair cover of thin spear grasses of low nutritive value.

The marine plains are much more extensive than the box and bauhinia plains and extend almost unbroken from the coast. They are extensive areas of grey loams and clay loam soils, fairly well drained and carrying a good body of grass, with various grasses, particularly Flinders and spear grasses, dominating the cover. The plains, which are almost treeless, are hard and compact. They are not subject to flooding from the tidal streams. The marine plains are six or seven miles wide and within about a mile of the coast give way to a light sandy timbered belt.

The coastal country is very well watered with permanent lagoons and creeks and shallow swamps, all of which break the continuity of the box and bauhinia plains. The marine plains are poorly watered; there are no lagoons and the shallow swamps give only temporary supplies. The poorer water supply system of the marine plains appears to be due to the fact that the numerous tributaries, distributaries and creeks, along the courses of which the lagoons are found, have formed up into the main streams such as the Scrutton and Nassau, which run direct to the sea. The swamps and lagoons of the box and bauhinia plains, and the shallow swamps of the marine plains, provide a certain amount of good swamp feed. However, there is very little marine couch on the shallow banks, so when the swamps dry out the cattle leave them and feed elsewhere. Apparently the hard clayey nature of the soils of the swamps and lagoons is not suitable for growth of marine couch, which, though present, is sparse and far from vigorous.

It is worthy of note that the whole terrain of the area under discussion (frontage, forest and coastal) is flat and devoid of any undulations or noticeable ridges. Those sand ridges which do occur here and there through the forest country are almost imperceptible to the casual traveller. From over 100 miles inland the country is practically flat to the coast, and beyond into the shallow gulf waters.

Plate 32.

Mixed Cattle, with an Admixture of Zebu Blood, on Frontage Country of the Gilbert.

Plate 33.

Forest Country off the Gilbert. This is rather better than most of the forest country in the area, but is still rather poor.

Plate 34.

Poor Forest Composed of Broad-leaved Tea-tree and "Gutta Percha."

TABLE 1.

AVERAGE MONTHLY RAINFALL RECORDS.

Recording Station.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Gilbert River . . . . (Average 65 years)	8·87	7·40	4·79	1·33	0·34	0·40	0·23	0·14	0·19	0·67	1·59	5·39	31·34
Miranda Downs . . (Average 34 years)	9·72	6·96	5·77	1·07	0·27	0·35	0·06	0·02	0·06	0·47	1·64	3·94	30·33
Mitchell River . . (Average 22 years)	12·54	12·21	10·47	2·37	0·19	0·27	0·05	0·19	0·11	0·41	1·89	7·42	48·12
Strathmore . . . . (Average 17 years)	9·48	6·33	6·29	0·78	0·09	0·70	0·34	0·18	0·06	0·46	1·50	4·80	31·01
Van Rook . . . . (Average 16 years)	7·74	7·45	7·12	1·00	0·05	0·63	0·17	0·27	0·05	0·42	2·11	5·19	32·20
Walsh River . . . . (Average 41 years)	8·33	7·18	6·67	1·28	0·43	0·39	0·19	0·05	0·10	0·60	1·62	6·11	32·95
Cumberland . . . . (Average 52 years)	7·66	5·98	4·10	0·95	0·40	0·53	0·23	0·24	0·23	0·52	1·39	4·84	27·07

Plate 35.
A Wattle Scrub Typical of the Vegetation on Some of the Ridges in Forest Country.

Plate 36.
A Permanent Waterhole in the Einasleigh.

CLIMATE.

The area lies mainly between the 30 and 45 inch average annual rainfall lines and is much safer from drought than any other major breeding (as distinct from fattening) area of the State. The figures for several properties are given in Table 1.

It will be seen that the main rainfall is received in January, February and March. Storms are responsible for most of the rain in the pre-wet season months of November and December. A perusal of records shows that the rains in December, January and February are fairly reliable, while those of November and March are more variable. Prolonged droughts do not occur, but when the normal dry period is extended by a dry March and a dry November, stock losses are experienced. These are due mainlv to the very low nutritive value of the dry feed rather than to shortage of surface water. Considerable additional losses may occur in these years because of the banks of many of the lagoons becoming boggy.

Temperature and humidity are important factors in the beef cattle industry of the area. The average maximum temperature at Georgetown, towards the headwaters of the Etheridge, is above 90 degrees for each month from September to March inclusive, and is over 82 degrees in the coldest months, June and July. The average monthly minimum temperature ranges from 53 degrees in July to 73 degrees in January. The relative humidity at this town is between 50 and 66 per cent. in all months except August to November.

Maximum and minimum temperatures are a few degrees higher on the Gulf coast than at Georgetown, and relative humidity is higher also.

Plate 37.

A Lagoon Off Dunbar Creek.

Plate 38.
Cattle Following the Green Shoot on Burnt Coastal Country.

Plate 39.
Good Plain Country Near Van Rook Creek.

Plate 40.

A Typical Plain of the Coastal Country.

Plate 41.

The Beginning of a Marine Plain.

CATTLE PRODUCTION.

Size of Holdings.

Most of the holdings are large, varying from 1,000 to 4,000 square miles, with carrying capacities from five up to twelve beasts to the square mile. The bulk of the cattle are carried on frontage country; most of the forest country carries no more than two beasts to the square mile, while some of it carries only one. When it is remembered that there is far more forest than frontage, it will be realised that most of the frontage country is called upon to support a fairly heavy cattle population. The coastal country carries a more even distribution of cattle and generally has a better carrying capacity than those places further inland.

The holdings are all Crown leases. The majority are held by large pastoral companies which are associated with meat companies.

Breeds of Cattle.

There is a great diversity of breeds throughout the area, or rather, a great variation in the combinations used. The breeds are Shorthorn, Devon and Hereford in many combinations, with the Devon-Shorthorn cross predominating. There are no straight herds of any breed and on only one holding is there any Zebu blood.

The Devon-Shorthorn cross is most favoured on account of its hardiness and apparent ability to "breed up" quickly after losses from drought or flood, but it is a very slow maturing beast in this area. Herefords appear to do fairly well but have the reputation of "running out" quickly unless high percentages of fresh bulls are kept up to the herd. This is a marked disadvantage in country where bulls are subject to tick and buffalo fly infestation.

On one holding, the infusion of some Zebu blood is being practised successfully. The absence of fences makes it impossible to control breeding, so the actual proportion of Zebu blood to that of British breeds is largely a matter of chance. The bulls that are used appear to be one-quarter to one-eighth Zebu, and they are used on crossbred cows that are a mixture of Shorthorn, Devon and Hereford, but mostly Devon-Shorthorn cross.

It is generally accepted that, under favourable conditions of environment, the Zebu is a slower maturing beast than the British breeds. However, when running on the tropical and relatively poor country of the Gulf and lower Peninsula, existing for six months of the year on coarse unpalatable grasses of low nutritive value, and contending with buffalo fly and cattle ticks, the Zebu-cross cattle grow better than the British breeds and their crosses can be turned off as stores at least twelve months earlier.

The vigour and robustness of the Zebu-cross bulls seen were outstanding, and in marked contrast to the comparative listlessness of the Devons, Shornhorns and Herefords. Calves and yearling stock carrying some Zebu blood appeared more robust and were growing more quickly than others of comparable age.

General Management.

This is not easy country to work and management presents many problems not experienced in other areas. Musterings are carried out throughout the wet season, this being the best time to handle cattle

from the forest country. It is difficult to muster the forest, but during the wet season cattle are forced out on to the frontage and on to the low sand ridges of the forest.

Weaning is not practised, owing to the fact that weaners would be forced to exist on natural pasture at a time when the grasses are at their lowest nutritional value. On those occasions when weaning has been practised, quite severe losses have at times been suffered, particularly amongst males, due to the cumulative setback of marking, then weaning, plus the drop in plane of nutrition.

Most runs are unfenced, but some have bullock ''paddocks'' into which are mustered males that are to be turned off the following year as stores. This is an important requirement of management of country which is used primarily for the breeding of stores for fattening elsewhere. When steers and bullocks are allowed to run with female cattle, the breeders suffer in the competition for feed. It is significant that under comparable seasonal conditions the percentage of brandings on those holdings which practise this feature of management is always much better than those which do not.

As the area is inferior ''growing'' country, it is preferable not to send bulls into it until they are ready for work. For this reason, most herd bulls are bred and grown in the better country, such as the Burdekin basin north of Charters Towers, and then sent out ready for work.

Plate 42.

A Stud Devon Bull on a Property on Which Herd Bulls are Bred for the Poorer Country.

In some of the Gulf coastal country, however, it seems to be the practice to breed the herd bulls on the place, and it is unusual to introduce any bulls. The principle of this method is that, by selection and culling, it is possible to develop a type or strain which has proved itself capable of flourishing (mere survival is not enough) in the particular environment. The success or failure of this method depends to a large extent upon the skill, knowledge and industry of the manager. Some of the cattle seen on a run where the method is practised were very good types of Devon-Shorthorn cross, indicating that the method has possibilities. However, with indifferent management, or breaks in continuity of policy, the system could degenerate into "mickey" and "scrubber" methods.

Spaying is practised fairly extensively. Spaying policy of directorates varies from time to time; it has been said to take the form of "spaying for age" without consideration of type and constitution, but a more rational policy is now operating.

It would be impossible to work the stations in this country without the reasonably adequate supply of aboriginal labour that appears to be available. Managers of holdings have a variety of duties to perform, and although some stations employ a book-keeper or a saddler, often the manager is also book-keeper, saddler, blacksmith and mechanic. Although there are some white stockmen on most holdings, occasionally one finds that all the stockmen are aborigines, with a half-caste in charge of mustering camps. These aborigines are mostly drawn from the Mission Stations, such as Mitchell River Mission.

One of the factors in successful management appears to be a knowledge and understanding of the practice of burning off. Although this practice is one which is the subject of much controversy in most parts of Queensland, all men in this part of the Peninsula seem to agree that burning off is a necessary part of management. It is realised that there are a number of generally undesirable features of burning-off, particularly the destruction of humus, and the creation of conditions suitable for soil erosion. Nevertheless, it is very likely that these do not operate in this area. There is no sign of soil erosion, and most managers try to get a "wet burn"—that is, they burn when there is a lot of moisture in the grass. In any case, it is significant that cattle prefer to feed on the burnt country carrying the green shoot and the best conditioned cattle are to be found on this type of feed.

On some of the best frontage country of the Gilbert, the feed is shorter and less rank than the average, and appears to maintain fair nutritive value beyond the usual limits. It is generally agreed that this particular type of country should not be burnt.

Cattle Turn-off.

The area is considered to be essentially breeding country and must be regarded as a reservoir from which stores are drawn to be fattened on better class country in other parts of the State. Except for the very few individual owners whose cattle are often bought by adjoining company stations, there is a regular movement each year from a particular breeding property to a particular fattening property. Breeding properties in the country of the Gilbert, Mitchell and Staaten Rivers are controlled by interests which hold fattening properties on the Saxby, Flinders and Leichhardt Rivers south of the Gulf.

The turn-off is fairly uniform from year to year, and though the actual numbers vary according to seasonal conditions, there is always some movement, and bad stock route conditions are rarely responsible for prevention of movement.

It was not possible, during the course of a brief visit to this vast area, to get an accurate idea of what annual brandings can normally be expected. The average expectation, however, in normal seasons, is approximately 25 per cent. brandings—that is, a place running 20,000 head expects to brand 5,000 calves. On holdings where young steers are removed from the general breeding herd, the managers expect about 30 per cent. brandings.

The total number of cattle in the area is below the figure which experienced men consider to be its normal carrying capacity. There were severe losses in the 1946 drought, and although these have not yet been made good, numbers have been increasing during the past few years and should almost be back to normal in 1951. There does not appear to have been any deterioration in the carrying capacity of individual properties and there is no evidence of a definite decline in cattle numbers.

INLAND KILLING AND AIR FREIGHTING.

Following the establishment of inland killing works at Glenroy in Western Australia, with air-freighting of carcases to Wyndham, a similar scheme for the Gulf and Peninsula was mooted. It was suggested that it may be possible to build works on the Gilbert or the Mitchell and air freight the carcases to Cairns, supplies of fat cattle to be obtained from stations in the Gilbert and Mitchell areas.

Investigation into this proposal revealed that, at present, it would have the following drawbacks:—

(i.) The country named as the source of fats is not suitable for fattening—it is breeding country, and any attempt to fatten on it would reduce its value as a reservoir of store cattle. It would not be possible to produce a killable beast under four years of age even with good seasons.

(ii.) At the ruling prices for store stock, the Gulf and Peninsula stations are receiving more for 3½-4 year old stores, station delivery, than they would get for 4-5 year old cattle killed at an inland works in the Gulf.

(iii.) The Glenroy venture has more chance of success than could be expected for a similar scheme in the Gulf, because Glenroy had no alternative outlet for cattle that would give comparable returns. The Gulf has an assured and profitable outlet for all the cattle that can be produced.

(iv.) Most of the country is held by pastoral companies which have controlling interests in breeding and fattening properties and substantial interests in export meatworks on the coast. It is hardly likely that the companies would alter their present programmes of breeding, fattening and marketing unless substantial financial benefit could be obtained. It is perhaps significant that when the Karumba works were operating, these companies maintained their major store cattle movements and sent only boners to the works. It is likely that the same thing would happen if an inland works were established. Some small owners may supply a limited number of fats and the company stations would supply some of their old cows as boners.

[TO BE CONTINUED.]

ASTRONOMICAL DATA FOR QUEENSLAND.

FEBRUARY.

Supplied by W. J. NEWELL, Hon. Secretary of The Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			MINUTES LATER THAN BRISBANE AT OTHER PLACES.					
Day.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	5.21	6.42	Cairns ..	41	17	Longreach	40	30
6	5.24	6.40	Charleville ..	29	25	Quilpie	34	36
11	5.29	6.35	Cloncurry	57	42	Rockhampton ..	15	5
16	5.32	6.32	Cunnamulla ..	28	30	Roma	34	16
21	5.35	6.28	Dirranbandi ..	18	20	Townsville ..	18	16
26	5.38	6.23	Emerald	24	14	Winton	46	34
28	5.39	6.21	Hughenden ..	42	27	Warwick	3	5

TIMES OF MOONRISE AND MOONSET.

At Brisbane.

Day.	Rise.	Set.
		p.m.
1	..	1.56
	a.m.	
2	12.26	3.05
3	1.24	4.11
4	2.29	5.10
5	3.39	6.02
6	4.50	6.46
7	5.57	7.23
8	7.01	7.57
9	8.02	8.27
10	8.59	8.57
11	9.56	9.27
12	10.52	9.59
13	11.48	10.33
	p.m.	
14	1.24	11.12
15	1.41	11.56
16	2.36	..
		a.m.
17	3.28	12.44
18	4.16	1.38
19	4.59	2.35
20	5.37	3.35
21	6.12	4.34
22	6.45	5.34
23	7.16	6.33
24	7.47	7.32
25	8.19	8.32
26	8.54	9.35
27	9.34	10.40
28	10.21	11.48

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

Charleville 27; Cunnamulla 29; Dirranbandi 19; Quilpie 35; Roma 17; Warwick 4.

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Day.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	28	10	44	25	19	0	52	28
6	27	13	43	28	18	3	51	13
11	15	24	31	40	6	15	35	46
16	9	31	25	46	0	22	26	54
21	14	26	29	42	4	17	33	49
26	25	14	42	29	16	4	48	33
28	30	11	45	25	20	0	53	28

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	51	5	65	34	49	20	42	6
3	56	2	68	32	52	17	46	3
5	54	7	67	35	51	21	44	8
7	43	18	60	43	45	27	36	17
9	32	29	52	50	36	35	26	25
11	20	40	44	58	29	43	18	34
13	11	49	38	63	23	49	10	41
15	3	56	34	67	18	53	4	46
17	2	57	33	68	17	53	3	47
19	7	53	36	66	20	51	7	44
21	16	45	41	60	26	46	14	37
23	27	34	48	54	33	39	22	29
25	38	23	56	45	41	30	32	20
28	54	6	67	34	51	20	44	7

Phases of the Moon.—New Moon, 6th February, 5.54 p.m.; First Quarter, 14th February, 6.55 a.m.; Full Moon, 22nd February, 7.12 a.m.; Last Quarter, 1st March, 8.59 a.m.

On 15th February the sun will rise and set 15 degrees south of true east and true west respectively, and on the 9th and 24th the moon will rise and set approximately at true east and true west respectively.

Mercury.—Still a morning object, in the constellation of Sagittarius, rising 1¾ hours before the sun at the beginning of the month and in the constellation of Aquarius, at the end of the month, rising ¾ hour before sunrise.

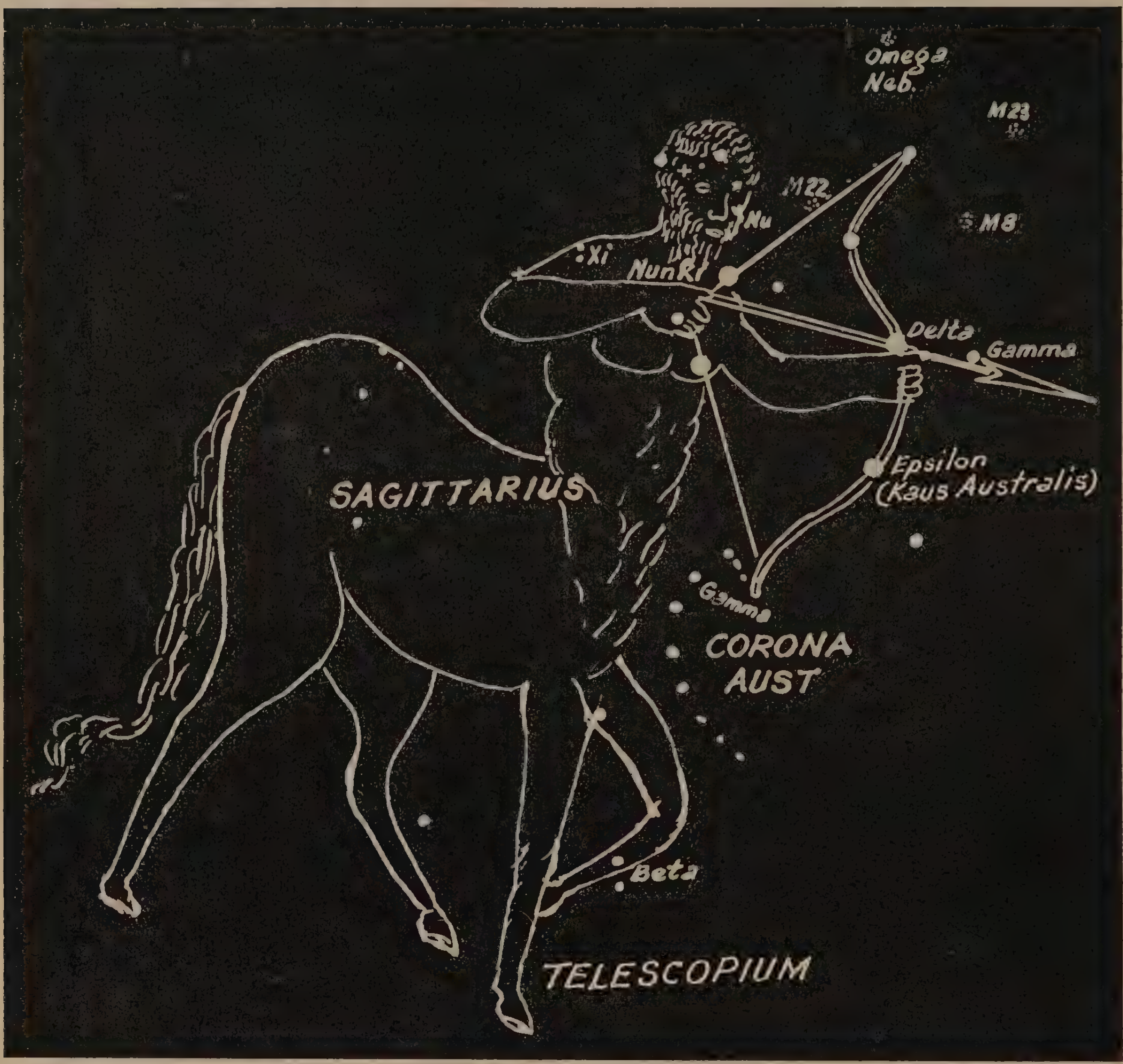
Venus.—In the constellation of Aquarius, at the beginning of the month, will set one hour after the sun and will pass Jupiter about the 11th and Mars about the 16th. By the end of the month, in the constellation of Pisces, will set 1½ hours after the sun.

Mars.—At the beginning of the month, in the constellation of Aquarius, will set about 1 hour 25 minutes after the sun, and after passing Jupiter about the 7th, by the end of the month, in the constellation of Pisces, will set 1 hour after the sun.

Jupiter.—Also in the western evening sky, setting 1½ hours after the sun at the beginning of February and ½ hour after sunset at the end of the month.

It will be interesting to watch the changing positions of Venus, Mars, and Jupiter during this month.

Saturn.—In the constellation of Virgo, at the beginning of February will rise between 9.15 p.m. and 10.30 p.m. and is now very suitably placed for observation. At the end of the month it will rise between 7.15 and 8.30 p.m.



THE CONSTELLATIONS.

Sagittarius (*The Archer*).—This is the most southerly constellation along the Zodiac and lies eastward of Scorpius; though it does not contain any first magnitude stars it adjoins the Milky Way and is very rich in faint stars, nebulae, clusters, doubles, &c. The Lagoon Nebula (M8), which is visible to the naked eye, is an indefinitely defined nebulosity, while Omega, or the Horseshoe Nebula, is a bright, large nebula shaped something like the figure "2." M22 is a bright globular cluster, about 15 minutes in diameter, which contains large ruddy stars; and M23 is an open cluster 47 minutes in diameter, with stars ranging from ninth to thirteenth magnitude. Both Delta and Epsilon are coloured doubles, while Beta is a wide double which can be seen with the naked eye. Gamma is also a double, one star being of fourth magnitude and the other of sixth magnitude. Xi and Nu are also naked eye pairs.

Sagittarius is shown as as centaur in the act of shooting an arrow from a bow, and the idea of a half man-half horse animal is said to have been developed from the wild race of men which inhabited Thessaly and who hunted on horseback.

In February the constellation rises about 3 a.m. and is seen as an evening object during the winter months, being on the meridian between 10 p.m. and 11 p.m. in July.

Corona Australis (*The Southern Crown*) adjoins Sagittarius and Scorpius, and is an unmistakable semicircle of fourth magnitude stars. Gamma is a binary of two fifth magnitude stars with a period of 120 years and is a good test for small telescopes.

Telescopium (*The Telescope*) is a modern constellation of small stars just south of Sagittarius and Corona Australis.

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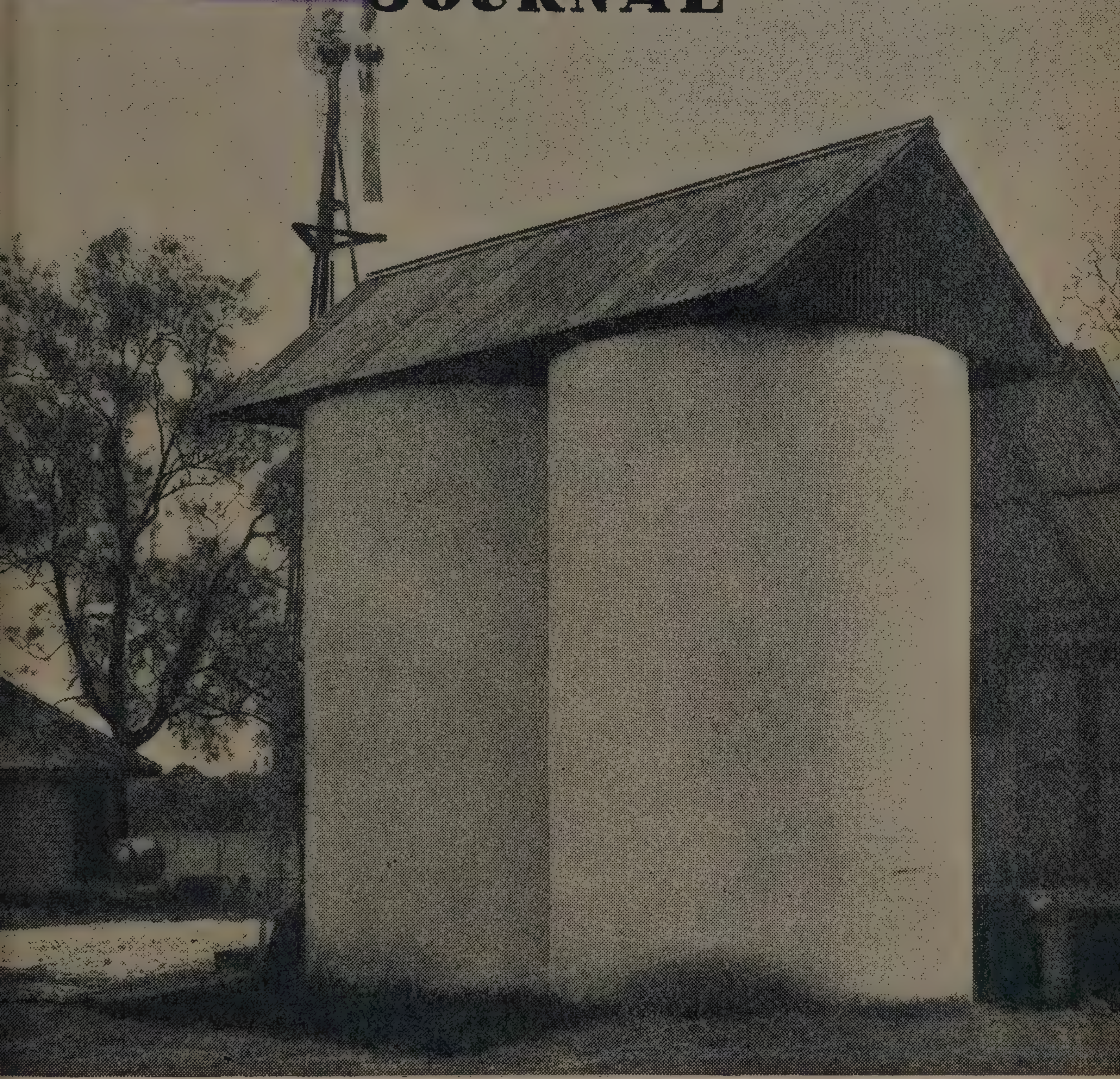
QUEENSLAND AGRICULTURAL JOURNAL



Ready for the Dry Spell.

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Peanut Growing

Pasture Management

Horticulture in the Burnett

Pasmo Disease of Linseed

Cream Defects

Feeding Floodbound Sheep

Warts in Cattle

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Contents

Peanut Growing in Queensland.

J. A. KERR (Plant Breeder) and W. J. CARTMILL (Senior Soils Technologist).

PEANUT growing in Queensland is largely concentrated in the South Burnett (Plate 43) of which Kingaroy is the centre. Appreciable quantities of peanuts, however, are produced in the Rockhampton district (Plate 44) and on the Atherton Tableland (Plate 45).

Plate 43.

A Field of Peanuts in the South Burnett District, the Main Production Area.

The peanut plant is a source of highly nutritious food for both human beings and farm livestock. The uses to which the crop is put are many, and its importance is steadily increasing. As a human food, the kernel is consumed raw, salted, or roasted and is used in various forms of confectionery; the oil is excellent for margarine manufacture. Peanut paste and oil are also marketed. Peanut meal, which remains after oil extraction, contains up to 48 per cent. crude protein and as a stock food ranks as a high-grade palatable product.

Plate 44.

A Peanut Crop at Rossmoya, Central District. Crown rot disease is responsible for the broken stand.

Plate 45.

Peanuts at Carbeen, on the Atherton Tableland.

The crop may be eaten down by pigs, but its consumption will result in objectionable qualities in the carcases. Breeding sows and weaners, however, may be fed limited amounts without detriment. The tops of the plant make a useful though rather coarse hay, which, overall, is not as good as cowpea hay in either yield or protein content.

The residue of the crop, after threshing to remove the nuts, is often stacked as reserve fodder. The trash as it leaves the thresher contains a proportion of light peanuts, and the food value is thus dependent to some extent on the percentage of peanuts remaining in the trash.

Peanut trash which is relatively free from soil is said by animal nutrition experts to have a higher feeding value for stock than is commonly recognised. It is true that the loss in vitamins during exposure is great, but the proteins, carbohydrates and mineral fractions are sufficiently high to make this by-product comparable in value with fair to good lucerne hay. It is interesting to note that the low fibre figure often allows cattle to eat daily several pounds more of peanut trash than they could of most hays. This means greater production than might be anticipated.

The peanut is regarded as being a native of Brazil, where several closely allied species are found. It is an annual summer-growing plant which is easily killed by frost, but it will adapt itself to a wide range of summer climatic conditions, provided the soil is suitable. Moderate rainfall, abundance of sunlight, and comparatively high temperatures, however, are necessary for best results with this crop.

The flavour of the kernel and the type of the shell enclosing it have led to the fruit of the peanut plant being incorrectly known as a nut; as the plant belongs to the pea family, the fruit is really a pod. Like other members of that family, its roots bear numerous nodules containing bacteria which make nitrogen in the air available to the plant.

The peanut plant grows to a height of from 12 to 18 inches and may have either a bunched or a running habit. The former type is preferred by farmers because, owing to its less straggling habit of growth, cultivation is much easier and harvesting is very much simpler than in the case of a variety possessing a running habit.

The flowers, which are small and yellow, are borne in the axils of the leaves. After pollination, the flower stalk elongates, bends downwards, and carries the developing pod into the soil (Plate 46). This flower stalk is commonly known as a peg, and the pod (Plate 47) does not develop unless the peg penetrates the soil.

The period of growth in the case of peanuts varies from 16 to 22 weeks, according to the variety, the district in which it is grown, and the seasonal conditions experienced during the growth of the crop. Early maturity is usually characteristic of the upright or Spanish type of plants.

The yield of peanuts per acre will naturally vary greatly with soil fertility and with the climatic conditions experienced during growth. Virginia Bunch yields average 1,700 lb. per acre, though 2,200 lb. is fairly common and 3,000 lb. occasionally exceeded. Red Spanish yields average 1,100 lb. per acre with high yields rarely more than 2,200 lb. The average bushel weight of peanuts as delivered by the thresher is 17 lb. for Virginia Bunch and 22 lb. for Red Spanish.

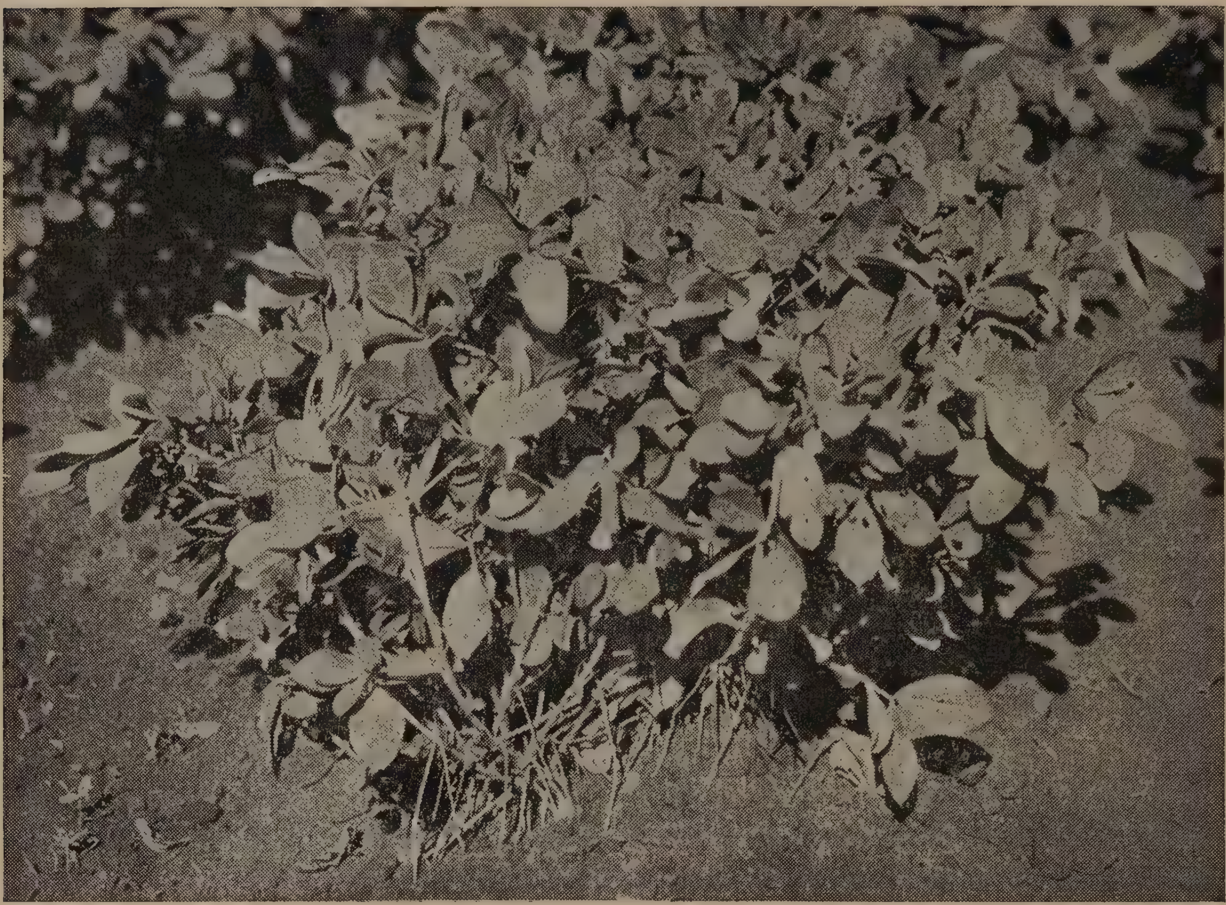


Plate 46.

A Peanut Plant in the "Pegging" Stage. The pegs are the very young pods, which mature in the ground.

Suitable Soils.

Well-drained, open-textured soils with a high humus content are the most suitable types for the growth of this crop. Satisfactory crops can be grown on a wide range of soils, but heavy soils which are inclined to become hard and compact should be avoided. Heavy soils frequently produce large crops of peanuts, but considerable losses are experienced when harvesting, particularly in varieties which readily shed the pod. Other things being equal, sandy loams usually produce the best results.

In Queensland, the crop is grown principally on the red volcanic loams which occur extensively in the South Burnett and on the Atherton Tableland. These are self-mulching, friable, well-drained soils of great depth and with a high level of fertility. Such desirable chemical and physical properties make them ideally suited to the production of peanuts. In the heavy rainfall districts of the Atherton Tableland, however, wet weather at harvesting, which may reduce the quality of the nut, is always a risk. Under intensive cultivation the granular-crumb structure of the red volcanic loams is liable to break down and their productivity to decrease as a consequence. Rotational cropping practices, preferably including a period under grassland, are particularly desirable on these soils to maintain or restore their productivity.

The crop is also grown on sandy loam soils in various parts of the State. While these soils all have a desirable physical condition, the low to moderate fertility status of some of them requires the use of fertilizers for satisfactory results. The light grey sandy soils tend to produce "pops" (no kernels in shell), particularly in Virginia Bunch. Deep sandy loams of alluvial origin are the most suitable types.

Plate 47.

A Peanut Plant Partly Pulled from the Soil to Show the Development of the Pods.

Rotations.

Observations indicate that the first crop of peanuts on a suitable soil is usually particularly good, yields of as much as 2,500 lb. per acre being frequently obtained with Virginia Bunch. Uninterrupted cropping with peanuts, however, soon reduces the yield to an uneconomic level, and in few crops grown under Queensland conditions is a suitable rotation more essential to the maintenance of a satisfactory standard of production than in peanuts.

The eradication of all weeds in the growing crop, which is essential for the successful production of peanuts, combined with the method of harvesting (entailing as it does the removal of practically the whole plant), results in a serious lowering of the humus content of the soil, with a consequent adverse effect on its physical structure. The total effect thereof is reflected in reduced yields. A lack of balance between the different soil nutrients following continuous cropping with peanuts probably also contributes to a reduction of yield.

The selection of suitable crops for rotating with peanuts depends upon the type of farming practised, but where dairying is combined with peanut growing the problem is somewhat simplified. Queensland climatic conditions are such that the main selections must be made from

summer crops, but these should be supplemented where possible by winter crops. Maize, grain sorghums, sweet sorghums, Sudan grass, white panicum and Japanese millet provide some of the possible selections for summer growing. Cowpeas should also be included in the rotation, but there is evidence to suggest that they should precede the abovementioned fodder crops rather than the peanut crop. All residues of ordinary crops included in the rotation should be ploughed in, and in the case of the more open soils it is recommended that a bulky fibrous crop, such as Sudan grass, should be included in the rotation and ploughed in as a green manure prior to the planting of the peanut crop. The beneficial results obtained from Rhodes grass as a soil renovator, indicated by first-crop peanut returns following that grass, suggest the adoption of the practice of grassing available cultivation areas from time to time for periods of from two to three years.

The restriction of peanut-growing to one crop in three years, or two crops in five or seven years, may prove to be necessary if satisfactory production is to be maintained. The benefits of the rotation will not be limited to the peanuts, but will also be apparent in the other crops which are included in the cropping programme. A rotation, however, must be adopted at an early stage in the development of a farm in order to achieve the highest degree of maintenance of soil fertility, and not merely as a measure adopted at a later date to restore the fertility of soils which have been mined rather than farmed.

In the Mareeba-Atherton area of the Atherton Tableland, crops of maize, velvet bean and cowpeas for seed, and tobacco are rotated with peanuts.

Land Preparation.

A field comparatively free from weeds should be selected for the production of peanuts in order to reduce hand work in the growing crop, and cultivation prior to planting should be thorough. A rotation which includes two or three years of Rhodes grass is very useful in checking weed population. If no cover crop is being grown during the winter, the first ploughing should be completed by the end of June, and, if the land is not being contour farmed, should be across the slope of the land, which is then allowed to lie in a rough state until the spring. On land subject to erosion, planting on the contour, in combination with contour banks and/or strip cropping, should be adopted. Spring ploughing should then be followed by cultivation to produce a loose, fairly fine seed-bed, and to conserve soil moisture by keeping weed growth in control. A further ploughing may be necessary, but the amount of cultivation required will naturally vary with the soil type and with the weather conditions.

In the Mareeba district, where rain in the early winter months may be negligible, it is common to plough in late March or April, especially on soils which tend to pack hard, in order to take advantage of soil moisture available from the summer wet season.

Fertilizers.

Peanuts make a heavy demand on the mineral plant foods of the soil, particularly calcium, phosphorus, and potassium. Nevertheless, the crop does not generally respond to fertilizers to the same extent as several other crops. When fertilizer has been applied to the crop in the rotation which immediately precedes the peanuts, it is usually not necessary to add more for the peanuts. In the principal peanut growing

districts of Queensland, fertilizers are not commonly used, though in some areas superphosphate applied at 2-3 cwt. per acre has given beneficial results. On light-textured soils of low or moderate fertility, it would be advisable to use a complete fertilizer mixture containing a high percentage of phosphate and a low percentage of nitrogen at rates of about 3 cwt. per acre if the soil has not been heavily fertilized for a preceding crop.

The fertilizer may be applied in the row before planting. It should be mixed with the soil or covered by a layer of soil so that it does not come in direct contact with the seed and thereby impair its germination. In the case of the red volcanic loams, close contact between the fertilizer and the soil is liable to render the phosphate unavailable to the plant and the practice of applying the fertilizer in a narrow band and covering it with a layer of soil is to be preferred to mixing it with the soil.

Use of Lime.

Calcium is a plant nutrient of major importance in peanut production. The supply of available calcium in the soil must be high for satisfactory yields. In the case of the large type peanuts, such as Virginia Bunch, a high percentage of unfilled shells in the harvested crop is usually an indication of a deficiency of available calcium in the soil. The smaller Spanish varieties do not seem to be affected as much in this respect by a low calcium status. The amount of available calcium in the fruiting (or pegging) zone has a marked influence on the development of the kernels. In areas where pops are prone to occur, either the soil should be limed or the crop topdressed with a relatively soluble source of calcium, such as gypsum (calcium sulphate). The latter practice is preferable as it ensures a supply of available calcium within the fruiting zone of the plant. The gypsum should be applied to the foliage of the plant at the early flowering stage, using about 3 cwt. per acre. If lime is used, 10-15 cwt. per acre should be broadcast three or four weeks prior to planting; higher rates are needed if the soil is very acid. It is desirable, however, to maintain the soil in a slightly to moderately acid state for the most satisfactory growth of the crop and the use of excessive quantities of lime should be avoided.

Varieties.

Only two varieties are grown extensively in Queensland, these being Virginia Bunch and Red Spanish (Plate 48).

Virginia Bunch is a strong-growing variety, and produces a large quantity of dark-green foliage. The plants, on suitable soils, may reach a height of 12 to 18 inches and a diameter of from 24 to 30 inches. The pods are usually borne fairly close to the centre of the plant, but late flowers may develop and fruit along almost the whole length of the branches. The pods are fairly smooth, of good size and shape, and usually contain two pale-coloured kernels. On maturity, these pods generally break off easily, thus resulting in loss in cases in which harvesting is delayed. Peanuts of the best quality of this variety are usually reserved for the "whole nut" trade.

Red Spanish has a smaller plant of semi-erect, bushy habit, with light green foliage. Its pods, which are closely clustered round the main stem, are small and completely filled with two dark-red kernels. At maturity, they do not break off easily, and so do not present a harvesting problem as may be the case with Virginia Bunch. On account of their

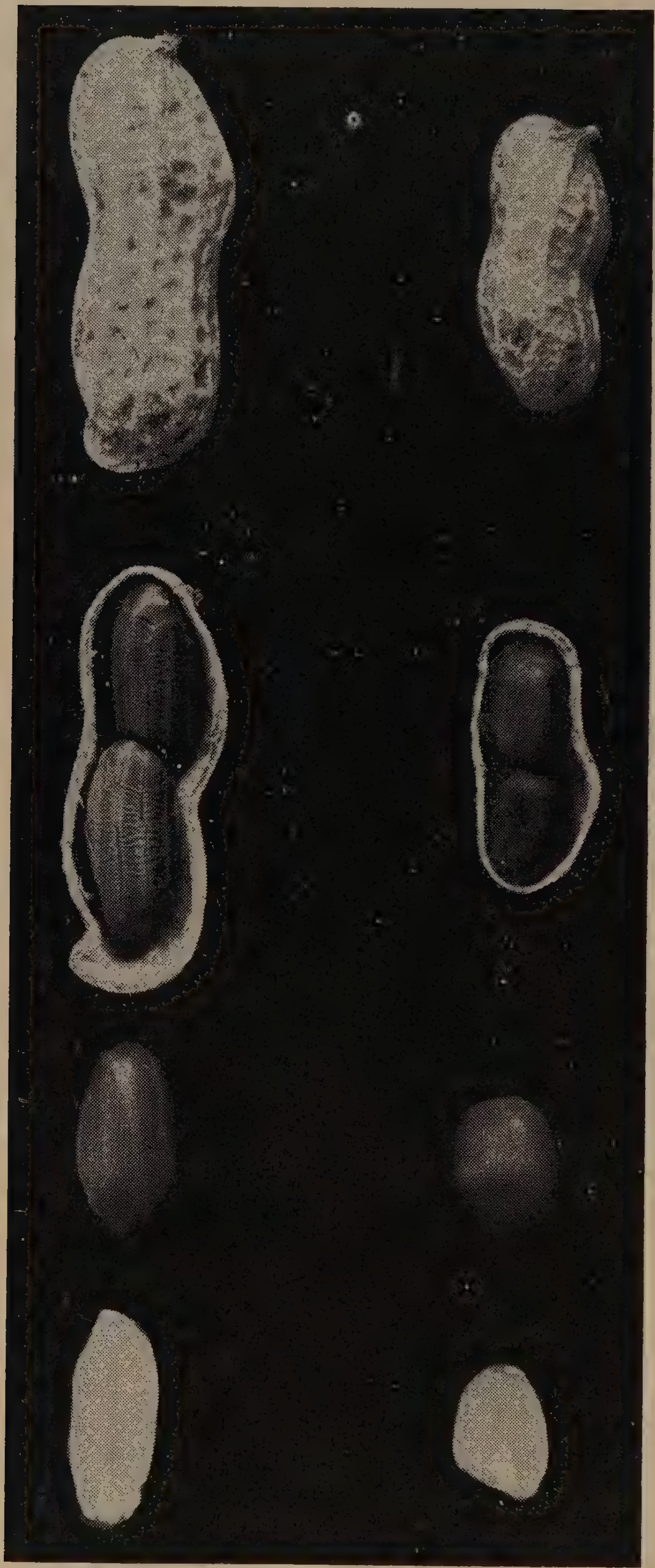


Plate 48.

Pods and Kernels of Virginia Bunch (left) and Red Spanish (right) Varieties.
The photograph is natural size.

high oil content, Red Spanish kernels are frequently used for the oil trade, but they are also used for the manufacture of peanut paste and are consumed as salted and devilled kernels.

In North Queensland, Red Spanish gives better results than Virginia Bunch in areas within the 30 inch rainfall belt, especially on the grey sandy loams.

Planting.

The planting season in Queensland extends from October to January, inclusive, December-January planting being favoured on the Atherton Tableland. Peanut planters and maize drills fitted with special peanut plates operate in a very satisfactory manner for planting. These mechanical planters plant shelled seed or kernels only, and with them even-graded seed is necessary to ensure the fairly regular spacing of plants. Small areas may also be planted by hand in shallow furrows opened at the desired spacing of the rows. When planting is done by hand, the use of kernels is not essential. The whole pod or the pod broken in halves may, therefore, be used, but the germination is slower than is the case with kernels. Soaking of the pods in water prior to planting may prove to be advantageous.

A width of 36 inches between rows and a plant spacing of from 10 to 15 inches is recommended for Virginia Bunch, this spacing requiring approximately 30 lb. of kernels per acre. For Red Spanish, a width of from 30 to 36 inches between the rows with a plant spacing of from 6 to 10 inches in the row is recommended. The kernel of Red Spanish is smaller than that of Virginia Bunch, and approximately 25 lb. per acre is therefore adequate for the closer spacing usually adopted in the case of the former variety. The seed should be sown at a depth of two to three inches.

The treatment of Virginia Bunch kernels with Ceresan, Agrosan, or a similar organic mercury dust for the purpose of checking the development of seedling diseases is very desirable in order to ensure a more satisfactory germination. Crown rot, however, is not entirely prevented by this treatment and it is a common practice to increase planting rates by as much as 25 per cent. of those recommended in order to provide for seedling losses.

Cultivation of the Crop.

Crop cultivation for the first month after planting may be carried out with light peanut harrows dragged across the rows. Ordinary light lever harrows may also be used. The initial harrowing may be done shortly after the plants appear, and the judicious use of the harrows in this early stage of the growth of the crop considerably reduces later hand work, since cross-harrowing eradicates many weeds in the row. The stand of young peanut plants is not harmed if the surface of the ground is free of debris. Inter-row cultivation should be continued until the first pods are developing. At least one hand chipping will probably be necessary to ensure the eradication of weeds. During the last cultivation a slight hilling is frequently given with the object of providing a free entrance for the fruiting pegs.

Harvesting.

As the peanut crop does not mature evenly, harvesting is carried out when the majority of the pods are mature. The plants at that stage usually develop a yellowing of the foliage, but as that is not invariably the case an examination of the pods is necessary before a decision is made to harvest the crop. When maturity has been reached, the inside of the shell usually begins to colour, at least at one end, and shows darkened veins. In the case of Virginia Bunch, a few of the early pods are usually lost, but no difficulty in this respect is experienced with Red Spanish, which retains its pods for a considerable period after they have reached maturity.

Although manual labour is still required at harvesting for the bulk of the crop, recent developments in mechanical harvesting are promising and reasonably efficient pick-up threshing has been in operation since the 1948-49 season. Indications are that all harvesting operations will be mechanised in the future.

Two rows of peanuts are cut by means of specially designed cutting blades directly attached to the tractor (Plate 49 and 50), and a side delivery rake, also attached to the tractor, moves the peanuts over into a windrow (Plate 51). Where the stand is light and plants small in size, four or more rows may be placed in the windrow.

The peanuts may be ready for threshing in about ten days, depending on weather conditions, but have been threshed satisfactorily after over ten weeks exposure in the field.

Variations to the headers used for threshing (Plate 52) include the fitting of pick-up attachments where such are not standard equipment, the replacement of standard rasp drums with peg drums, the enlargement of elevators, and the fitting of special sieves and shakers. Results have generally been very satisfactory when operating with Red Spanish but variable with Virginia Bunch.

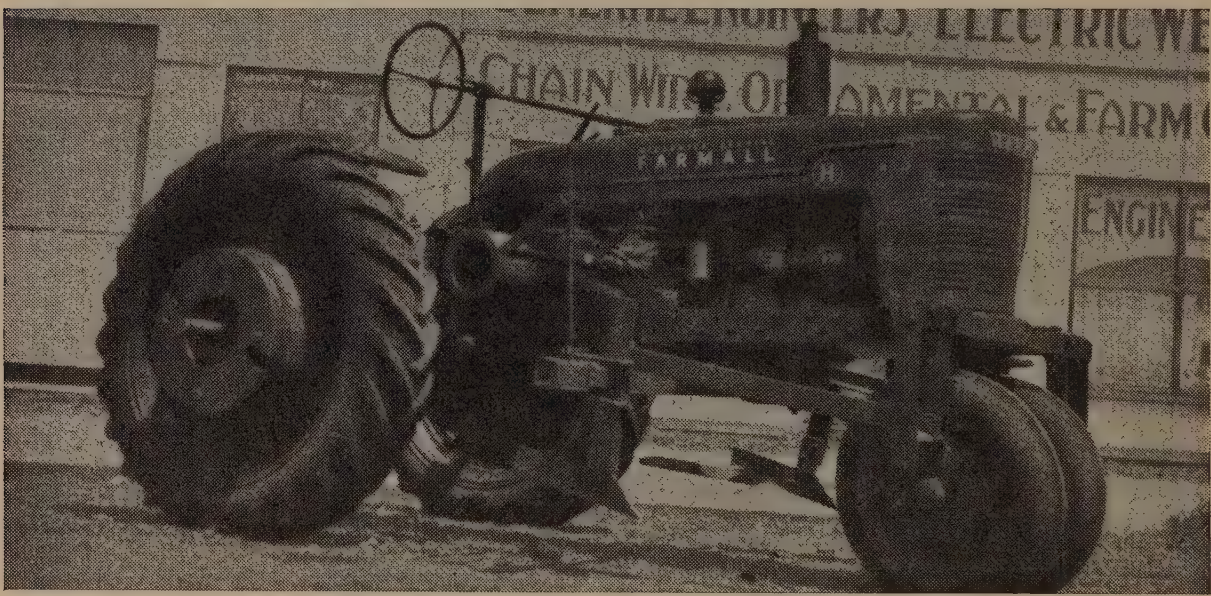


Plate 49.
A Tractor Fitted With a Pair of Peanut Cutters.

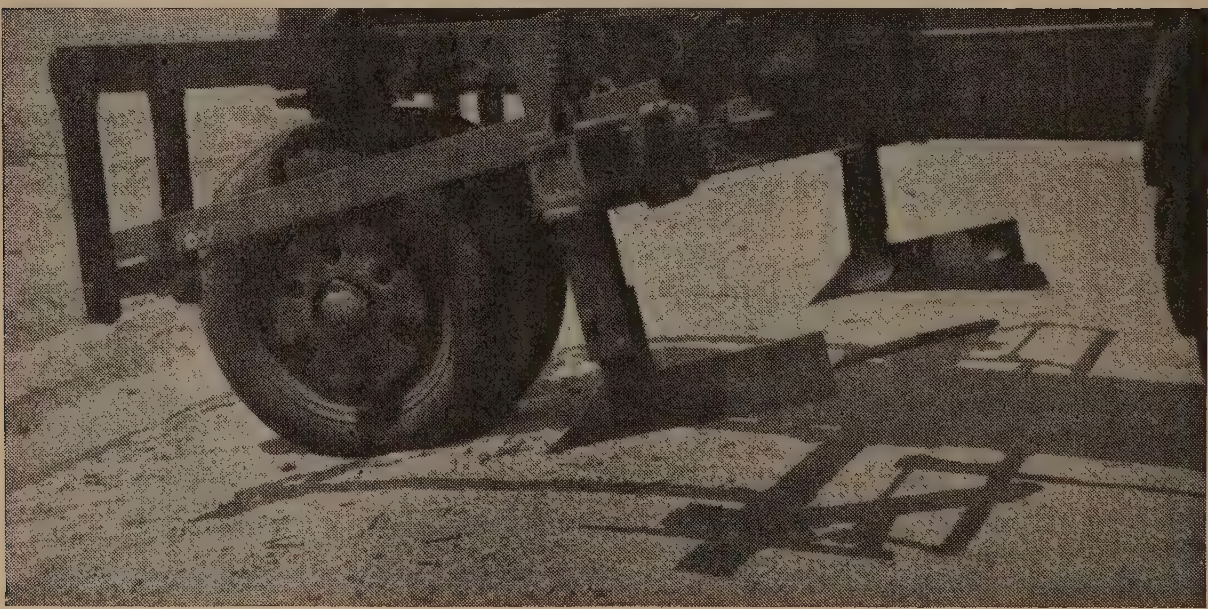


Plate 50.
View of Cutters Attached to a Tractor.

Plate 51.

A Side Delivery Rake Windrowing Peanuts for Pick-up Threshing.

Plate 52.

A Converted Harvester Picking Up Peanuts for Threshing.

An experimental machine designed especially for pick-up threshing is being built at Kingaroy. This method of harvesting will be adopted by a large number of growers when equipment is more readily available.

Several machines have been developed to cut, pull and deposit peanut plants in bundles in readiness for stooking, but none has proved entirely satisfactory. An efficient machine which pulls two rows of peanuts and diverts them to a single central windrow from which they may be hand sorted and stooked has recently been marketed.

When hand harvesting, the tap root is usually cut by means of specially designed cutting blades, adjusted to cut just below the level of the peanuts in the soil. A slight tilt of the cutting blades loosens the soil around the plants and thereby facilitates pulling. Cutters are generally attached in pairs on tractors, but small areas may be cut by single cutters attached to horse-drawn cultivators. Though rarely used in the main peanut growing areas, a single furrow mouldboard plough with the mouldboard removed will act as a satisfactory cutter, but the attachment of a special share with an extended blade improves the cutting.

After cutting, the plants are pulled by hand and placed in bundles of a size convenient for handling when stooking, the soil being simultaneously shaken from the plants.

The usual practice is to stook the plants without support. The plants from eight to twelve rows are generally placed in a single line of stooks (Plate 53), the average size of the stooks being about 36 inches in diameter and 42 inches in height. The first plants are placed on the ground with the pods upwards, followed by some other outer plants with the pods towards the centre. The stooks can then be built in successive layers, each bundle of plants being firmly placed in position with the pods always to the centre of the stook. The last 12 inches are tapered to a point and capped by a plant with the foliage directed downwards with the object of shedding as much rain as possible.

Plate 53.

Stooked Peanuts Curing in the Field.

On the Atherton Tableland, especially in the high rainfall districts, the practice is to make fairly large stacks rather than stooks. This is carried out by the use of slides, on to which the plants are loaded and then driven to the stack. The load is anchored by stakes and the slides pulled out from beneath, leaving the load in position. The plants are stacked with the nuts out, to reduce moulding and discoloration of the nuts. While this system has merit, it is probable that normal stooking, combined with periodic turning of stooks in wet weather, would give better results.

Stacking around poles may be used for curing the crop prior to threshing, but the method is rarely adopted in Queensland now. For this purpose, poles about seven feet long are driven firmly into the ground and two cross-pieces three feet long are nailed on to the poles at right angles to each other about nine inches from the ground. The first plants are placed on these cross-pieces in order to keep the pods off the ground, and the stack is then built round the pole with the pods inside. Towards the top of the pole the plants are arranged so as to taper off the stooks gradually. It is capped by using inverted peanut plants or grass. From twenty to thirty poles are required per acre for curing the crop in this manner.

Dry weather is essential for the first week after pulling, in order to allow the plants to dry, but after that period has elapsed, rain damage is usually of minor importance, provided the wet weather does not continue for a long period. Unfavourable harvesting weather produces a darkening of the pods, and moulds may develop under such conditions, with a consequent loss of quality; moulds may even cause the destruction of a large percentage of the crop.

Plate 54.
Cured Peanuts Being Threshed by a Mobile Thresher.

The peanut plants may remain in the stooks for a period of from 14 to 28 days, the duration of the period depending on the prevailing weather conditions. The plants must be dry and the pods must shatter easily from the pegs before threshing is attempted. Threshing is usually done by contractors who operate machines designed for handling this crop (Plate 54). The stooks are generally conveyed on low wagons to the thresher, which is moved from time to time to convenient positions in the field. The plant residue, after the thresher has removed the pods, is frequently stacked in the field in the position in which it is delivered from the threshing machine and is subsequently used as fodder.

Marketing.

The Peanut Marketing Board controls the marketing of the crop. The Board operates extensive silos, shelling and cleaning machinery and other equipment. The main storage facilities are at Kingaroy (Plate 55), but there are also depots at Brisbane, Atherton and Rockhampton.

Plate 55.

Peanut Silos and Treatment Plant at Kingaroy.

Ownership of the peanut silos, other buildings and fixed assets is vested in a holding association known as The Queensland Peanut Growers' Co-operative Association Limited, registered under "The Primary Producers' Co-operative Associations Acts." Members of the Association are the suppliers of peanuts to The Peanut Marketing Board established under "The Primary Producers' Organization and Marketing Acts," and the rules of the Association provide that the directors shall be the members from time to time of the Board. By this means the Association has been able to provide storage accommodation for the Board at Kingaroy, Rockhampton and Atherton.

Pests and Diseases.*

Since the commencement of peanut growing on a commercial scale in Queensland, the activities of insect pests in the crop have, from time to time, attracted attention. Compared with some other cultivated crops the toll taken by insects in peanuts is relatively light. However, some species can at times cause considerable damage. They are pea mite, white grubs, brown scarab beetle, crown borer, corn ear worm, green vegetable bug, and mealy bugs. Two minor pests are red-shouldered leaf beetle and a small scarabeid beetle.

The diseases of peanuts are of much greater importance, one of them, crown rot, being frequently responsible for greatly depleted stands. The control of this disease depends on both seed treatment and on cultural conditions which maintain a good soil structure. Crop rotation is discussed elsewhere in this article and the adoption of the practices there recommended will minimise the risk of loss from crown rot. The fungus *Sclerotium rolfsii* causes a rot of mature or nearly mature plants which is regarded as a serious disease. Other diseases, including leaf-spot, wilt, bunchy plant and spotted wilt, are less serious.

Further information on pests and diseases of peanuts is contained in Departmental publications which can be obtained on application.

* Notes contributed by the Science Branch.

The Effect of Pasture Management on White Clover.

O. L. HASSELL, Senior Adviser in Agriculture.

THE solution of many pasture problems lies in good management. Good management requires that the farm should be well subdivided into small paddocks, so that pasture renovation, rotational grazing, rotational cropping, manure spreading and harrowing, and cutting or heavy grazing of pastures at certain periods may be carried out efficiently.

The plant foods usually employed for stimulating pasture growth are phosphates and nitrogen. Phosphates assist the root development of the grasses and legumes, and the nitrogenous fertilizers are especially valuable in promoting the leaf growth of grasses. Phosphates are applied to the soil in the form of superphosphate, but the nitrogen is best supplied by incorporating a legume with the pastures.

The problem in most Queensland pastures is to provide a protein-rich supplement to the ordinary carbohydrate-rich grasses. The productivity of a grass growing in association with a legume is higher than that of the same grass growing in a pure stand, so that mixed pastures of a grass and a legume, in addition to having a higher feeding value than single type pastures, may be expected to yield more heavily than pure grass stands.

Many coastal farmers in southern Queensland are able to make good use of white clover as a legume for the improvement of their pastures, but good management is necessary to make the most effective use of this plant.

A Brisbane District Example.

A striking example of how pasture management may be employed to maintain white clover in paspalum paddocks is provided on the "Brookland" farm of Mr. W. S. Conochie at Sherwood, in the Brisbane district. Seen in September, 1950, most of the pasture contained an extremely useful proportion of white clover. In several paddocks which had been closed to stock for some weeks, the clover was in full flower, about twelve inches high and suitable for haymaking.

According to Mr. Conochie, small patches of clover were first noticed growing in watercourses on the property about 1925, and since then it has spread over the whole property, the seed being carried by stock.

The pasture managment on this farm might well serve as an example to other farmers whose land can grow clover. The essential features of Mr. Conochie's system are:—

(*a*) Subdivision and rotational grazing;

(*b*) Control of summer growth of paspalum by mowing or stocking to ensure that white clover will develop well in the winter and spring months;

(*c*) Manure spreading and mowing to check weeds or patches of coarse grass growth, as required at any time of the year.

Plate 56.
Jersey Cows Grazing on Paspalum-White Clover Pastures at "Brookland," Sherwood.
Photo by "Queensland Country Life."

The property covers 65 acres, of which there are 12 acres of swamp-land. The remainder of the farm is sub-divided into small paddocks which average about 2½ acres each, the largest being four acres. Fodder crops are cultivated on eight acres, the rest being under pasture. Fourteen acres of managed pasture provide all the grazing for 24 head of high producing, milking Jersey cows. The balance of the pasture is used for dry cows, young stock and working horses, totalling an additional 40 head.

On the cultivation, either a pure stand or a mixture of wheat and field peas or tares is grown each year for winter and spring fodder, followed by summer crops of maize and cowpeas, also for green fodder. When summer pasture is abundant, the cowpeas are not cut for fodder but are ploughed in as a green manure crop. The guiding principle of the cropping system is to plant the crops at regular intervals of time in order to provide a reserve of green fodder for stall feeding to the milking cows throughout the year to the fullest extent that seasonal conditions will allow.

Effect of Mowing.

The pasture paddocks on which it is desired to have a good clover growth are mown twice during the summer months. If there is a good growth of grass at the time of mowing, the mown grass is made into hay, raked and stored in the hay shed for later feeding to the herd. Usually the first cutting is made between early December and late January and the second mowing is made in the February–March period. The exact time of mowing is dependent on the type of summer rainfall season experienced. Different paddocks are mown each year. Some judgment needs to be exercised in determining how large an area of the summer pasture should be mown. Too large an area may be a disadvantage, as a dry winter and spring may result in pasture shortage. Under these conditions, removal of the grass cover causes a

rapid drying out of the surface soil and the mown pasture does not then make much growth. Of the 14 acres of managed pasture on Mr. Conochie's farm, up to eight acres may be mown twice in the summer season. Failure to carry out summer mowings on paddocks where there is a heavy growth of paspalum usually results in smothering of the clover regrowth in the following winter.

Plate 57.
Clover Development in a Paddock Mown in December and February.

Plate 58.
Paddock Mown Only Once (Early December). Clover is not so evident as in paddocks mown twice in summer.

Heavy stocking on the summer pasture, of course, will achieve a similar effect to mowing, although in this case a light mowing is also usually resorted to in order to cut back any weeds and patches of rank grass growth. The mown material is left lying in the paddock.

Plate 59.

Clover Development Resulting from Close Grazing During Summer.

Other advantages claimed for mowing the paspalum are, firstly, that seeding of the paspalum is delayed, thus apparently reducing the occurrence of ergot; and, secondly, that mowing results in a greater production of young protein-rich, palatable grass while growing conditions are favourable.

The pasture paddocks are regularly worked over following rain with a home-made clod crusher slide, frequently with a harrow attached behind, in order to break up and distribute cow manure. Attention to manure spreading is a feature of pasture management on this property.

The virtues of pasture management are well illustrated by the fact that a paddock less than an acre in area, which developed a heavy growth of clover in the winter, provided grazing for 20 milking Jersey cows for half an hour, night and morning, for a fortnight before it required spelling. Stock were removed on 22nd August and by 16th October the pasture was about four inches high and suitable for light grazing again. It was allowed to stand over, however, and when inspected on 17th November there was a lush growth of an excellent mixture of paspalum and white clover, averaging 10 inches in height.

Pasture hay is made on this property whenever there is a suitable opportunity. The growing conditions of the winter and spring of 1950 enabled an excellent cut of clover hay to be made in August and of a mixture of paspalum and clover hay, containing some burr medic, in October. Mr. Conochie finds that grass hay is a very useful supplementary feed, especially when clover growth is at a peak in the winter and spring months, as it checks scouring in the cows.

Although the provision of protein-rich pasturage and the utilization of pasture hay and farm grown green fodder crops constitute the foundation of Mr. Conochie's stock feeding system, he still finds it necessary and profitable to purchase and feed additional concentrates to make the fullest use of the high producing capacity of his herd.

Horticultural Districts of Queensland.

6. The Burnett and Adjacent Coast.

A. A. ROSS (Horticulturist) and S. J. KUSKIE (Inspector, Diseases in Plants Acts).

THE Burnett River drains an area of approximately 15,000 square miles, its watershed being bounded on the west by the Auburn Range, which is about 150 miles from the sea, on the north by the Dawes Range, and on the south by Craig's Range (Plate 60).

The Burnett flows through open forest country of a sub-coastal tableland (Plate 61) for the greater length of its course and breaks through a gap in the Coast Range and descends on to the coastal plain to run into the sea at Burnett Heads. At its mouth it is sufficiently deep to admit coastal shipping to the city of Bundaberg, which is some six miles from the sea.

The Burnett district assumes the general form of a coastal plain from 30 to 50 miles wide rising to a sub-coastal tableland which extends a further 100 miles to the west. The eastern edge of this tableland is bounded by the Coast, Bin Bin and Burnett ranges and the western edge by the Auburn Range, which is part of the Great Dividing Range. This tableland is 397 feet above sea level at Biggenden, and rises gradually to Monto (774 feet) in the north-west, and to Wondai (1,058 feet) in the south. On this sub-coastal tableland, grazing, dairying and general agriculture are the main rural pursuits, while horticultural crops are grown on specially selected sites. Biggenden, Gayndah, Mundubbera, Eidsvold and Monto are the chief towns in that portion of the district usually referred to as the Central Burnett, and Kingaroy, Wondai, Murgon and Goomeri are the main centres in the South Burnett.

In the north, the coastal plain is traversed by several relatively short rivers, which rise in the Coast Range. In the south, the Mary River, which is comparable to the Burnett in size, runs northwards, roughly parallel to the coast, and receives several streams of moderate size which rise in the Coast Range. A comparatively large propor-

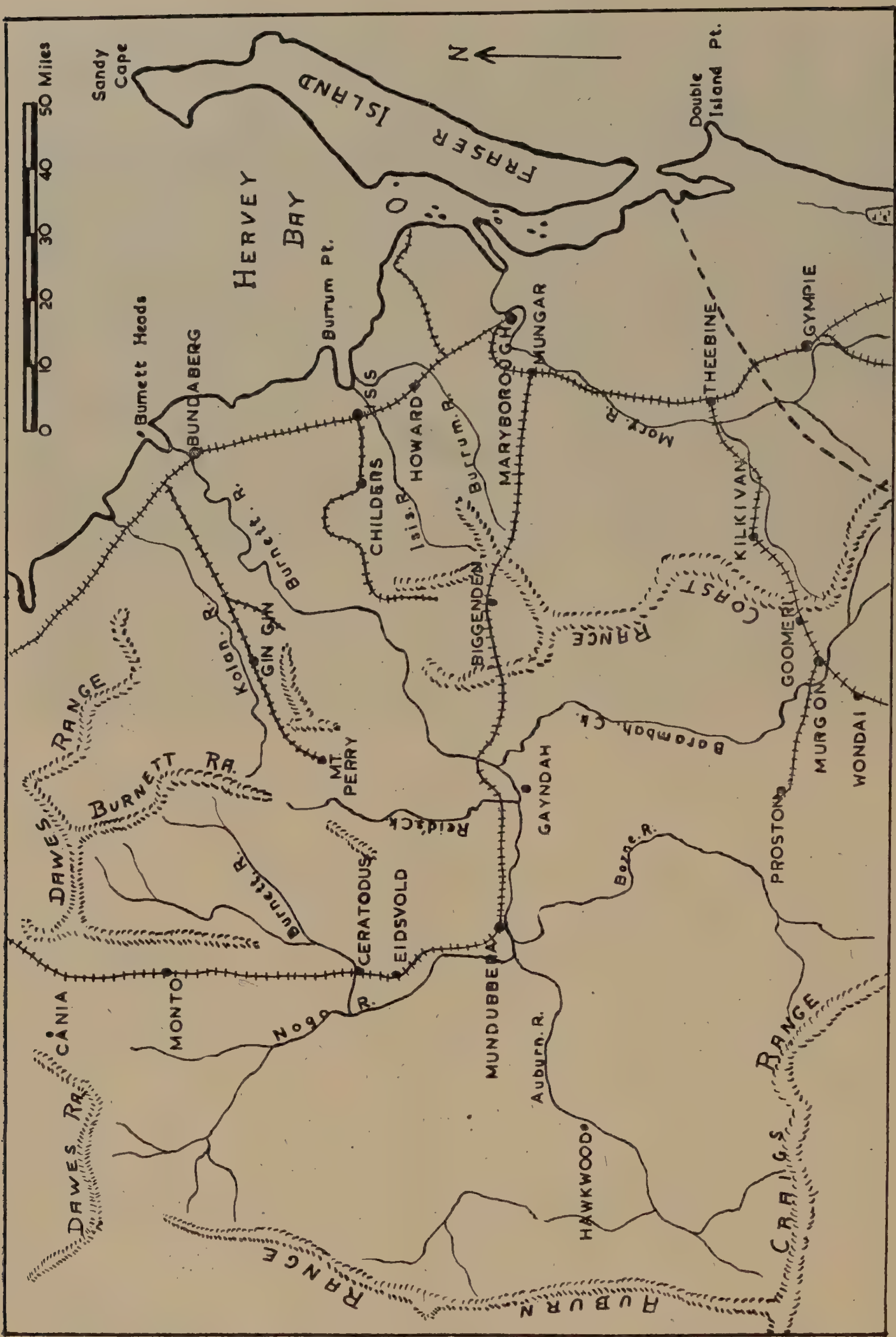


Plate 60.

Sketch Map of the Burnett District. The south-eastern corner forms part of North Coast District.

tion of this coastal area is devoted to sugar cane growing and dairying, and horticultural industries have not been greatly developed. The cities of Bundaberg and Maryborough, each with a population of approximately 15,000, and several smaller centres such as Gin Gin, Childers, Howard, Pialba and Urangan, are located on the coastal plain.

The district is well served by railways and roads. The main north-south railway passes through the principal coastal towns, and branch lines leaving the main line at Theebine, Mungar, Isis and Bundaberg provide access to the South Burnett, Central Burnett, Isis, and Mount Perry areas, respectively.

Plate 61.
The Burnett River Near Gayndah.

CLIMATE.

The district lies between latitudes 24½ and 26½, so the climate (Table 1) may be referred to as sub-tropical. The climate of the coastal plain country is greatly influenced by the proximity of the sea, there being no natural barrier to the prevailing easterly winds. This tends to restrict the temperature range, making heavy frosts in winter rather exceptional and high summer temperatures infrequent. Further inland, winter frosts increase in both frequency and severity with altitude and distance from the sea, while summer temperatures are higher and sustained for longer periods. As is to be expected, relative humidity is generally higher along the coast.

Rainfall in coastal towns ranges from 40 to 50 inches annually, and inland from 25 to 30 inches. It occurs mainly in late summer, and particularly during late January and February. It is the rule for spring weather to be dry and this is liable to have a deleterious effect on fruit crops which are not irrigated.

NATIVE VEGETATION.

There is a marked difference between the vegetation on the coastal plain and that on the sub-coastal tableland. The former comprises four main types of formation, namely:—

(1.) Coastal sand dune flora, including rank grasses of poor fodder value and trees such as the coastal sand cypress (*Callitris columnellaris*), sometimes known as cypress pine, casuarinas and banksias.

TABLE 1.

METEOROLOGICAL DATA FOR THE BURNETT DISTRICT.

—	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec.	Year.
Mean Maximum Temperature (°F.)													
Bundaberg	85·6	85·7	84·1	81·4	76·6	72·6	71·9	73·7	77·3	80·5	83·4	85·8	79·9
Gayndah	89·8	89·4	87·1	83·8	77·9	72·6	71·8	74·8	80·9	85·9	89·6	91·1	82·9
Maryborough	86·3	85·8	84·0	80·7	75·7	71·8	70·8	73·1	77·6	82·0	85·3	87·2	80·0
Mean Minimum Temperature (°F.)													
Bundaberg	69·5	69·4	67·0	62·4	55·3	51·9	48·7	49·9	55·3	60·6	65·2	68·9	60·3
Gayndah	66·2	66·3	62·6	56·1	48·0	44·4	41·2	42·3	48·7	55·6	61·4	65·4	54·8
Maryborough	68·2	68·4	66·0	61·4	54·0	51·2	46·6	48·2	53·8	59·0	63·8	67·3	59·0
Mean Relative Humidity (%)													
Bundaberg	70	71	73	71	72	75	73	70	65	63	62	64	69
Gayndah	66	68	68	65	65	68	66	62	59	58	59	62	64
Maryborough	70	73	74	75	74	77	74	70	64	61	62	64	70
Average Rainfall (points)													
Bundaberg	920	619	519	312	263	296	180	131	164	199	246	493	4,342
Gayndah	479	431	307	141	157	189	144	118	157	233	281	411	3,048
Maryborough	731	667	596	378	302	308	186	169	194	269	313	502	4,615
Monto	432	411	357	160	184	171	206	94	95	208	309	341	2,948

(2.) Wallum, which includes a dense growth of relatively short growing shrubs, such as leptospermum, boronia, and epacris, together with short twisted trees such as banksia and tea trees (species of *Melaleuca*) and grass trees (species of *Xanthorrhoea*).

(3.) An open forest formation containing a variety of eucalypts, of which red bloodwood (*E. corymbosa*) and stringy bark (*E acmenioides*) are predominant, accompanied by a range of wattles, banksias, tea trees and grass trees.

(4.) On the ridges rising towards the Coast Range, a denser forest formation containing tall straight trees of excellent milling quality; prominent species are spotted gum (*Eucalyptus maculata*), red bloodwood, flooded gum (*E. saligna*), tallow-wood (*E. microcorys*), and southern kauri pine (*Agathis robusta*).

The inland country of the Burnett district is mostly open fores which carries a comparatively dense cover of native grasses such as Queensland blue (*Dichanthium sericeum*), Burnett blue (*Bothriochloa intermedia*), bunched spear (*Heteropogon contortus*), and three awned spear (*Aristida striata*). Several introduced grasses are thriving well in this district, namely Rhodes (*Chloris gayana*), green panic (*Panicum maximum* var. *trichoglume*), and buffel (*Cenchrus ciliaris*). The trees in this country are mainly those which withstand drought well, such as grey ironbark (*Eucalyptus paniculata*), narrow-leaved iron-bark (*E. crebra*), silver-leaved ironbark (*E. melanophloia*), grey box (*E. hemiphloia*), poplar box (*E. populifolia*), Moreton Bay ash (*E. tesselaris*), and numerous wattles. On poorly drained flats with heavy soils, brigalow (*Acacia harpophylla*) is a common tree. Along the rivers and creeks a typical river bank flora is developed which includes blue gum (*Eucalyptus tereticornis*), Moreton Bay ash, Portuguese elm (*Celtis sinensis*), tea trees, and several figs.

SOILS.

As is to be expected in so large an expanse of territory, a wide range of soil types is found, and in the development of the country, land usage has followed the distribution of the various types of soils. The poorer, shallower soils capable of carrying only a fair grass cover are devoted to grazing on a wide scale. Better class soils with a clay-loam texture are used for the production of agricultural crops, while horticultural crops are confined to specially selected soils which lend themselves to intensive systems of management.

On the coastal plain, the soils used for the production of horticultural crops can be broadly grouped into three classes:—

(1) Alluvial soils, which are for the most part light textured, deep and well drained. They occur along the coastal rivers, and at points above tidal influence are adjacent to good supplies of water for irrigation. It is this soil type which is used mostly for citrus growing in the Howard-Burrum-Torbanlea district.

(2) Volcanic residual soils, mostly red in colour, which occur in isolated places, usually on hilltops or overlying a basaltic flow. The largest development of this type is in the vicinity of Bundaberg on the slopes of the Hummock. These soils

are well supplied with plant nutrients and frequently have a good supply of underground water. They are suitable for a wide range of horticultural crops, including vegetables, bananas, pineapples, and sub-tropical tree fruits.

(3) Medium textured, light coloured, residual soils derived from sedimentary rocks such as shales and sandstones. These are relatively shallow and not suitable for tree crops. They frequently occur on elevated slopes where the frost hazard is reduced, and conditions are suitable for pineapples.

In the inland portion of the district two main soil types are used for horticultural purposes. Other soils would probably be satisfactory for vegetables but they are not used extensively for this purpose. Soils of horticultural interest at present are:—

(1) Alluvial river bank soils of light texture, free drainage and great depth. Approximately 25 years ago most of these were over-run by prickly pear, but numerous citrus orchards now flourish on them.

(2) Volcanic residual soils, generally red in colour, loamy in texture and well supplied with plant foods. They are generally developed on plateaux or spurs of the main ranges and are well protected against frost. They are frequently used for tropical fruit crops such as bananas, pineapples and passion fruit, and provide a source of these fruits for local consumption.

HORTICULTURAL CROPS.

Citrus.

All species of commercial citrus fruits are grown in the district and the locations most commonly chosen for orchards lie close to the rivers or subsidiary creeks (Plate 62). There are two reasons for this. Firstly, in such places the soil is most suitable, being deep, of light texture and well drained. Secondly, for best results, the natural rainfall needs to be supplemented by irrigation; although the total annual rainfall is above 25 inches, its distribution is somewhat erratic and in most years a dry spring is experienced.

Plate 62.

Citrus Orchard at Burrum. Young trees in foreground; older trees behind.

Plate 63.

Overhead Irrigation in Citrus. Irrigation ensures consistent cropping in most varieties and is particularly necessary in a dry spring or early summer.

Citrus growing is well-developed in the Central Burnett in the vicinity of the towns of Biggenden, Gayndah, Mundubbera, and Eidsvold. Here, the orchards are all serviced with irrigation, the plants being owned and operated by individual growers. The water is pumped direct from watercourses and is applied in all cases by means of portable spray lines (Plate 63). In this area high grade navel oranges and lemons are produced, while mandarins also thrive particularly well. Mid-season and late varieties of oranges, such as Joppa and Valencia, are grown only to a limited extent, the early varieties being preferred. The main lemon variety is Villa Franca, the Lisbon having fallen into disfavour on account of its thorniness. Glen Retreat and Ellendale (Plate 64) are the chief mandarin varieties, and both are in demand on southern and export markets. Grapefruit mature early in this district and usually are marketed in southern cities towards the end of March.

On the coast, the Howard-Burrum-Torbanlea district produces approximately the same quantity of citrus fruits as the Central Burnett. Here, however, mandarins and mid-season and late oranges are the main commercial lines. Most orchards are situated on the banks of the coastal rivers, particularly the Burrum, but several have been established on selected sites away from the watercourses where the soil has been found suitable. Irrigation is not generally practised in this area as the coastal rivers are tidal for many miles from their mouths and only those properties above salt-water mark and those with a dam or some other storage structure possess irrigation facilities. In this part of the district the principal varieties of citrus grown are Emperor mandarins, and Joppa and Late Valencia oranges. Navel oranges do not set profitable crops in many seasons, while lemons are troubled with gum diseases and do not develop as good a quality as they do further inland.

Plate 64.

Ellendale Mandarin. A late maturing variety which thrives in inland areas and is very popular on southern markets.

Plate 65.

Pineapple Plantation at Nikenbah. The soil is a basaltic loam not far from the coast.

Pineapples.

Pineapples are grown mostly on the coastal plain on ridges where frost is not particularly severe. Largest plantings are in the Nikenbah area in close proximity to the sea on hilly country of volcanic origin (Plate 65). Around Aramara, on the foothills of the Coast Range, an area of frost-free land with suitable soil produces pineapples of a high standard. There are also several excellent pineapple plantations in the Bundaberg area on relatively flat land.

In the inland portions of this district, only the plateaux are suitable for pineapple culture, as low-lying land is subject to frosts which are sufficiently severe to prevent the growth of the crop. Several of these plateaux are found throughout the district, carrying a soil of volcanic origin, usually red in colour, and very fertile when first cleared of the heavy vegetation which it supports in its natural state.

Bananas.

To a great extent, bananas are grown on similar sites to those used for pineapples, that is, on coastal hillsides (Plate 66) and inland plateaux. Inland, the rainfall is rather too light to produce vigorous growth and consistently high yields. Tall growing varieties such as Lady Finger and Sugar are most successful, but there is scope for the introduction of a plant improvement programme to provide better planting material.

Plate 66.

Lady Finger Bananas. Tall varieties such as Lady Finger do well near the coast.

Vegetable Crops.

Large scale truck-crop growing has not developed in this district, due mainly to the absence of big local markets. Several small market gardens are found close to the towns, but only in the Bundaberg area are vegetable crops grown to any extent for marketing elsewhere. Here, beans are grown as a winter crop, mostly under irrigation, the principal variety being Brown Beauty. Odd crops of tomatoes are grown, usually on a small scale, for southern markets.

Macadamia Nuts.

The Macadamia or Queensland nut grows wild in the hilly country of the Coast Range and several commercial plantations have been developed from the seed of these native trees (Plate 67). For

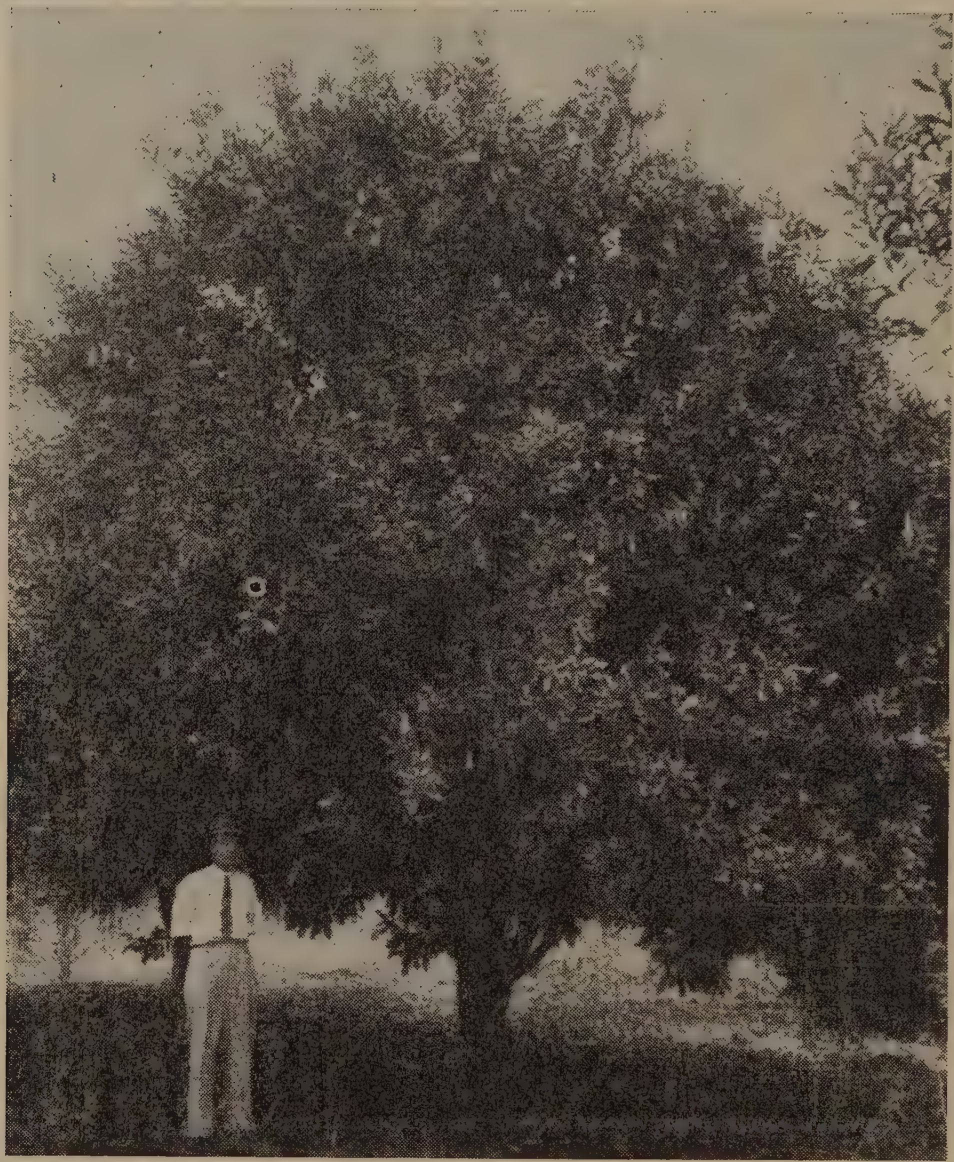


Plate 67.

Macadamia Nut Tree. The tree is native to the coastal scrubs and is grown on an orchard scale to supply expanding markets.

the most part, the smooth leaf or integrifolia variety is predominant in this area. Generally, smoothness and thickness of shell characterise this variety, and amongst them many attractive strains are found. The commercial plantations are all at present on the coastal plain and trees are growing very satisfactorily. However, there exists a wide range of types, several very desirable, but many somewhat poor, which is only to be expected within a population of seedlings. Superior strains have recently been selected and by asexual propagation of these it is expected that high yielding, uniform plantations will be established.

Passion Fruit.

Several areas of passion fruit are established in parts of the district, their location being decided mostly by freedom from frosts. Some excellent crops are produced in the Bundaberg district, and on

several of the plateaux of the sub-coastal tableland, growers have taken advantage of the comparative warmth of the situation. Unfortunately, woodiness, brown spot and Fusarium diseases have penetrated practically all these areas and regular rotational planting is necessary.

Rockmelons.

Rockmelons provide a very profitable sideline for citrus growers in inland areas, especially for those whose orchards are not yet bearing. Because of the lower rainfall and relative humidity of inland compared with coastal areas, the incidence of mildew is not severe and in most seasons crops can be raised successfully. The netted varieties such as Hales Best are preferred and these are usually marketed towards the end of November and early December, when they meet a ready demand in southern capitals.

POTENTIALITIES.

There is not a great area of virgin land suitable for citrus growing available in the present main areas of production. That which remains is mostly in small broken areas where working methods would be complicated. While much suitable soil is to be found along the upper reaches of the Burnett River, low winter temperatures are liable to cause heavy losses from frost. The town of Eidsvold approximately marks the upper boundary of successful citrus production.

Greatest scope for horticultural expansion in this district lies in the development of the production of sub-tropical fruits, such as avocadoes, Macadamia nuts and custard apples, and vegetables. The area most suitable for such expansion is on the coastal plain north from Maryborough. Development will proceed provided irrigation facilities and worthwhile markets are available.

In the country adjacent to Bundaberg, not assigned to sugar cane, the comparative mildness of the climate should allow the successful production of many varieties of truck crops, especially those which lend themselves to transport to southern markets, and tropical fruit such as pineapples and the tall growing varieties of bananas. A frequent air service operating between the coastal cities and southern capitals should result in the commercial production of strawberries.

The whole of the district is subject to recurring droughts and consequently the horticultural industries can only be made safe by the provision of reliable irrigation. While the total annual rainfall is sufficient to support most crops, its monthly distribution is very erratic and periods of temporary droughts are frequent. Also, rainfall varies considerably from year to year, and in all years irrigation is a necessity if high production of quality goods is to be achieved.

MARKETING.

Most of the fruit produced in this district is marketed on distant markets and consequently must be carefully packed in standard containers. Citrus growers all operate their own packing sheds which, for the most part, are well equipped with up-to-date machinery. In no part of the district is co-operative marketing attempted.

There are two market agents in Bundaberg and one in Maryborough who sell produce daily by auction. These are relatively small establishments designed mainly to meet the needs of local retailers. Vegetable crops are almost entirely marketed through these channels at present.

In Maryborough there is a factory which processes certain of the raw products of the district, producing such things as candied peel, marmalade, pickles, and orange wine.

PRODUCTION STATISTICS.

Current production of horticultural crops in the Burnett district is summarised in Table 2. The more interesting points to be noted are the present importance of citrus and pineapples and the scope for expansion in the area under sub-tropical tree fruits and vegetables.

TABLE 2.

HORTICULTURAL PRODUCTION—BURNETT DISTRICT (1948–49).

FRUIT.

Crop.	Not Bearing.	Bearing.	Production.
	Trees.	Trees.	
Citrus—			
Navel Oranges	9,284	9,388	41,505 bush.
Valencia Oranges	9,429	14,492	31,011 bush.
Other Oranges	6,508	16,140	34,976 bush.
Lemons	3,909	10,555	43,534 bush.
Mandarins	10,331	37,834	80,764 bush.
Grapefruit	1,941	2,697	12,881 bush.
Other Citrus	129	45	29 bush.
Other Orchard Fruits—			
Custard Apples	351	755	1,494 bush.
Mangoes	423	653	1,319 bush.
Nuts	267	476	6,100 lb.
Other Orchard Fruit	301	116	55 bush.
	Acres.	Acres.	
Grapes (Table)	1	18	15,135 lb.
Plantation Fruit—			
Bananas	73	88	4,619 1¼ bush. cases
Pineapples	198	415	85,784 1½ bush. cases
Papaws	15	45	7,820 bush.
Passion Fruit	16	16	4,286 half-bush. cases
Strawberries	..	1	658 lb.

VEGETABLES.

Crop.	Acreage.	Production.
Potatoes	459	964 tons
Sweet Potatoes	20	63 tons
Turnips	18	60 tons
Carrots	12	654 cwt.
Beetroot	11	519 cwt.
Onions	3	5 tons
Tomatoes	62	10,973 half-bush. cases
French Beans	115	7,695 bush. cases
Green Peas	60	2,851 bush.
Cabbages	43	16,219 doz.
Cauliflower	15	1,226 doz.
Lettuce	1	130 bush.
Melons—Water	57	240 tons
Rock	118	523 tons
Pumpkins	429	1,160 tons
Marrows and Squashes	6	12 tons
Cucumbers	38	1,975 bush.

Approved Strawberry Runners.

FOR some years past the Department of Agriculture and Stock has been operating an approval scheme for strawberry runners designed to reduce the incidence of strawberry virus diseases and to improve the general quality of strawberry planting material.

The crops of the following growers were inspected during the past season and found to be free or practically free from virus diseases and to be grown under good cultural conditions. These growers may now sell their runners as "Approved by the Department of Agriculture and Stock."

Grower.	Address.	Variety.
L. Kocho	Image Flat road, Nambour	Phenomenal
W. B. Stuffins	Pringle road, Nambour	Phenomenal
W. Thomas	West Woombye road, Woombye	Phenomenal
C. Armstrong	Old Bowling Green road, Palmwoods	Phenomenal
G. Armstrong	Old Bowling Green road, Palmwoods	Phenomenal
J. Bowden	Old Bowling Green road, Palmwoods	Phenomenal
C. L. Tompkins	Old Bowling Green road, Palmwoods	Phenomenal and Aurie
A. H. Rann	Western road, Montville	Phenomenal and Aurie
J. Wilson	Western road, Montville	Phenomenal and Aurie
R. B. and G. G. Deans	Zillmere road, Boondall	Phenomenal
W. Sulnman	Sandgate road, Boondall	Phenomenal
J. B. McLauchlin	Upper Mount Gravatt	Phenomenal
G. W. Franklin	Mains road, Sunnybank	Phenomenal
W. A. Mackley	Brandon road, Runcorn	Phenomenal
W. J. Akers, Jnr.	Underwood road, Eight Mile Plains	Phenomenal
A. Fels	Underwood road, Eight Mile Plains	Phenomenal
E. H. Lambley	Birkdale	Phenomenal
D. J. Brown	Cleveland	Phenomenal
L. H. Keating	Pinklands, *via* Cleveland	Phenomenal
G. E. Lax	Pinklands, *via* Cleveland	Phenomenal

1951 SHOW DATES.

February.

Warwick	7, 8 and 9
Clifton	22 and 23

March.

Pittsworth	6 and 7
Killarney	9 and 10
Oakey	16 and 17
Sydney	16 to 27
Chinchilla	29, 30 and 31

April.

Tara	3 and 4
Miles	5, 6 and 7
Wandoan	9 and 10
Toowoomba	14 to 19
Blackbutt	20 and 21
Jandowae	23 and 24
Dalby	26, 27 and 28
Monto	27 and 28
Warrillview	28

April—continued.

Nanango	26, 27 and 28
Goondiwindi	28 and 30
Taroom	30, May 1 and 2

May.

Kingaroy	3, 4 and 5
Barcaldine	3 and 4
Beaudesert	4 and 5
Wallumbilla	4 and 5
Mundubbera	4 and 5
Longreach	8, 9 and 10
Roma	9 and 10
Ipswich	8, 9 and 10
Murgon	10, 11 and 12
Mitchell	16 and 17
Blackall	15, 16 and 17
Thangool	17 and 18
Marburg	18 and 19
Kilkivan	18 and 19
Charleville	23 and 24

[*Continued on page* 115.]

PLANT PROTECTION

Pasmo Disease of Linseed.

T. McKNIGHT, Pathologist, Science Branch.

THE following notes on pasmo disease will acquaint linseed growers with the symptoms of this disease and with the measures at present available for its control. As the disease has only recently appeared in Queensland, investigational work is in a preliminary stage. However, determinations of the resistance of individual plant selections from the varieties Walsh and Golden Viking are being made, in addition to the testing of new linseed varieties for their resistance to this disease. Certain other avenues likely to lead to effective control, such as the influence of time of planting and the use of recently developed seed treatments, are being explored by officers of the Department of Agriculture and Stock.

Pasmo disease, caused by the fungus *Sphaerella linorum,* appeared for the first time in Queensland in maturing crops of Walsh on the Darling Downs in November, 1949. This highly infectious disease quickly established itself and spread with great rapidity under conditions of showery weather and high humidity. In the crop harvested late in 1950, no disease-free crop has been detected in the Darling Downs, Kingaroy and Lockyer Valley districts, where the bulk of Queensland's linseed is produced.

The disease is present in practically all of the linseed growing countries of the world. In Australia, it appeared in Victoria in 1940 and was recorded for the first time in New South Wales in 1948.

In Queensland, good conditions for the development of the fungus early in the life of the crop result in stem girdling near ground level and the death of the main stem, and losses from this disease may then be of the order of 5 to 50 per cent. Fortunately, the disease is more often confined to the post-flowering period, and if the bolls are well developed at the time of attack, although the plant may be severely blighted at harvest time, the yield may not be materially reduced. However, a severe attack at the commencement of this period results in the production of light-weight, crimped and shrivelled seed which is frequently discoloured, as well as in a proportion of the bolls failing to set.

Symptoms.

The earliest symptoms of the disease are shown by the seed leaves and young true leaves, on which small brown lesions appear. Generally no further symptoms are noticed until the flowering and post-flowering periods, but in several crops in 1950, when the stems were a foot or more in height a single pasmo lesion which encircled the stem was formed near ground level and resulted in the collapse of the plant.

Plate 68.

Symptoms of Pasmo Disease of Linseed. Left, spotting and destruction of leaves. Right, stem markings.

The prominent leaf symptoms appear as the plant approaches the flowering period, when the fungus produces circular grey to greyish brown spots (Plate 68, left) which soon merge to produce irregular dead areas, killing the whole leaf. The infected leaves become dark brown to black, curl up and fall to the ground, or adhere to the stem by their whole surface in wet weather. The surface of the leaf lesions is studded with numerous black spots, just visible to the naked eye. These are pycnidia, or the fruiting bodies of the fungus, and contain the spores which spread the disease. During moist weather tendrils of spores extend from the ripe pycnidia.

As the leaf blighting proceeds from the bottom of the stem upwards to involve the whole of the leaves, prominent elongated oval brown lesions commonly about half an inch in length (Plate 68, right) appear on the stems. In the early stages of stem infection, the alternating of the brown lesions with the green or greenish yellow colour of the stem produces a very characteristic mottled appearance. These stem lesions coalesce to form a dead area girdling the stem. Simultaneously, long lesions occur on the boll stalks together with more or less circular lesions on the bolls and on the calyx.

Sources of Infection.

It has been shown that the pasmo fungus can be seed-borne. After the crop has been harvested, great masses of spores remain on the stubble. Crop debris carrying the infection is, therefore, a means of carrying the fungus over from year to year. The fungus can also be carried over from one season to another on volunteer linseed plants. There is strong circumstantial evidence that the disease may be distributed by wind.

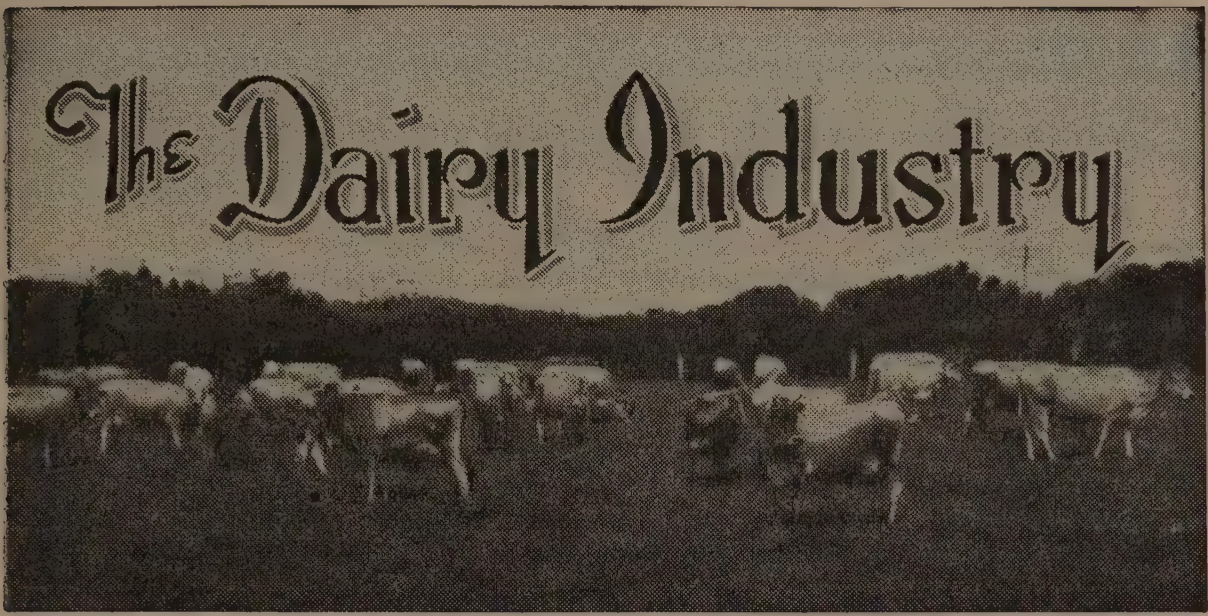
Control.

It is now obvious that this disease will be as widespread in incidence, and will produce much the same effects on the plant, as the leaf and stem rust fungi do on cereals. The Department of Agriculture and Stock is testing new varieties and is making plant selections in an endeavour to find some resistance to this disease. In the meantime the principal control measures are crop rotation and seed treatment.

All crop debris should be ploughed in deeply after the harvest, and a system of crop rotation should be employed, sowing linseed only once in every three or four years in the same land. While the measure is only partly effective in controlling the pasmo fungus, it is recommended that routine dusting of seed should be carried out, using an organic mercury compound at the rate of 3 oz. per bushel.

Cheese Production—Rockview's Good Figures.

The Rockview Cheese Factory made 96·97 per cent. first grade cheese and 3·03 per cent. second grade in the year 1949-50. The figures were given incorrectly as 76·25 and 23·75 in the December issue of the Journal.



Cream Defects—Probable Causes and Prevention.

E. B. RICE, Director of Dairying.

MOST defects which cause a lowering of cream quality are of bacterial origin, but some are caused in other ways. Every care should therefore be taken during production and while the cream is held on the farm to remove or minimise sources of contamination.

The common defects of cream, their probable causes, and methods of prevention are set out below. Any producer whose cream is being degraded at a factory should, by referring to the notes on the specific defect which is occurring in his produce, be able to bring about a prompt improvement in quality if the appropriate action is taken in connection with his milking shed methods.

Absorbed Flavours.

Caused by absorption of odours from nearby surroundings; engine exhaust fumes; coal tar; oil from engine or on separator block; smoke from dairy fire; paint; vegetables or fruit stored in dairy; kerosene; benzine.

Prevention.—Keep milking shed, separator room and dairy tidy; do not use the dairy for storage of anything other than milk or cream; lead exhaust away from dairy; and keep strong-smelling substances away from cream.

Albuminous.

Abnormal milk due to cow's physical condition; using cream of freshly calved cows; late lactation cream; cows wading in swamps.

Prevention.—Reject abnormal milk; wash thoroughly udders of cows which have waded in swamps (chlorine solution 100 parts per million is advised).

Bitter.

Certain weeds eaten by cows; milk from cows late in lactation; protein-attacking bacteria.

Prevention.—If due to food consumed, graze such pastures immediately after milking and keep cows away from suspected paddocks three hours before milking. Dry off any cow in an advanced stage of lactation which may be causing the trouble. (Test such cow's milk individually by holding for 24 hours and noting if bitter.)

Cheesy.

General insanitation (cheesy cream is always graded second or rejected); straining milk or cream through cheese-cloth; unclean machines. High temperature and infrequent delivery will accentuate this defect.

Prevention.—A complete overhaul of shed practices is indicated; avoid cheese-cloth strainers and use cotton filter discs; keep brushware clean by washing and drying; use only seamless utensils.

Cowy or Cowyard.

Unclean bails and yards, and bad drainage, the smell often being drawn through teat-cups, or taken up by cream stored in unsatisfactory surroundings; dirty udders and hands; milk from unhealthy cows, or cows milked too soon after calving; general insanitation.

Prevention.—Take the necessary precautions during and after production of cream to avoid contamination from the sources indicated. Reject abnormal milk from freshly-calved or sick cows. An overhaul of production methods is indicated if the cause is general insanitation.

Curdy.

High acidity caused by holding cream at too high a temperature; failure to blend cream properly; skimming too thin; leaving skimming dishes out of separator bowl; neglect to stir cream.

Prevention.—Separate cream to give at least a 36 test in winter and a 40-44 test in summer; cool cream; do not mix hot with cold cream; stir cream several times daily.

Disinfectant Flavours.

Odorous disinfectants used in shed or for washing cows' teats; handling disinfectants and not washing hands before milking; using salves, carbolic compounds, or other strong disinfectants on cows' udders.

Prevention.—Avoid using carbolic and other odorous disinfectants in the cowshed; carefully follow instructions if chlorine compounds are used in the dairy.

Feed Flavours.

Cows fed silage, lucerne, clovers (green, and as hay), mouldy or musty hay, turnips, onions, especially if within three hours of milking.

Prevention.—If practicable, flavour-tainting feeds should be fed straight after milking; remove cows from such feeds at least three hours before milking. Aeration and cooling tends to diminish feed flavour. Modern factory processing usually removes feed taints from cream.

Fermented, Gassy, Yeasty.

General uncleanliness, particularly due to yeasts and gas-forming bacteria; washing separator only once daily; improperly cared for milking machines; wood stirrer; mixing hot and cold cream; dirty yards and bails. Infrequency of delivery to factory and high temperatures aggravate these defects.

Prevention.—Production methods should be carefully revised; remove manure from yard daily; do not use rag strainers or wash-up cloths; use only seamless utensils. Clean utensils, clean hands, clean udders and cooling are the essentials of control.

Machine Taint.

Unclean and fat-saturated inflations and rubber tubing; unclean air pipeline and vacuum tank.

Prevention.—Carefully wash and steam-sterilize milking machine; renew perished inflations and rubber tubes; clean vacuum tank and airline.

Metallic.

Holding cream in vessels, the tinning of which is imperfect; rusty utensils; pitted milking machine pipelines; using kerosene tins for buckets.

Prevention.—Have faulty utensils retinned or replaced; avoid using rusty, broken or dented utensils; all dairy utensils should be seamless.

Overripe, Sour, High Acid.

Excessive acidity, due to failure to cool and hold cream at low temperature (not over 70 degrees F.); keeping cream too long on the farm or infrequent delivery to factory; use of unclean utensils, separator or milking machine; separating cream at too low a test; careless dairy methods.

Prevention.—Use thoroughly clean and near-sterile utensils; cool cream and keep cool; deliver to factory as frequently as practicable; separate cream at 40-44 test in summer and at least 36 test in winter; stir cream occasionally.

Rancid.

Result of advanced undesirable bacterial fermentation; cream is low second grade or reject quality.

Prevention.—Same methods as for cheesy defect apply.

Ropy.

Result chiefly of bacteria in water supplies, especially in swamps and dams. Cows pick up the "ropy" germs on their udders, and later they become established in the utensils and bails.

Prevention.—Stop access of cows to possible sources of contamination; wipe udders well (chlorine is advised); whitewash bails; clean up yard; thoroughly clean and sterilize utensils after use and rinse them with chlorine solution (100 p.p.m.) just before next milking.

Slimy.

Flushing separator bowl with hot water; use of too small separator; unhealthy cows; access to stagnant water; newly-calved cows.

Prevention.—Do not flush separator bowl with water; fence off stagnant water, in dams, swamps, &c.; reject milk of freshly-calved and unhealthy cows.

Stale.

Cream kept too long on farm; high temperatures aggravate this defect.

Prevention.—Cooling of cream and frequent delivery to factory; hygienic shed methods.

Tallowy, Oxidised.

Advanced stage of metallic defect; exposure of cream to direct rays of sun; placing cream in cans kept in sun; cream of excessive fat content.

Prevention.—As for metallic defect. Protect cream from the sun's rays; separate cream at 40-44 test in summer and at least 36 test in winter. Stir cream occasionally.

Unclean, "Off" Flavour, "Tainted."

Faulty shed methods, particularly the use of cheese-cloth or rags as strainers instead of cotton-wool filter discs; dirty milking machines; dirty udder cloths; wet-hand milking; imperfectly cleansed utensils; use of cloths for washing-up; dirty wash-water; leaky milk float in separator; unwashed separator; wooden stirrer; dirty manure-laden cowyard; milking machine airline.

Prevention.—Milk with clean hands; wash udders; reject cloth strainers and wash-up cloths, and use only brushes; use near-sterile utensils; cool cream; renew perished inflations and rubber tubing; deliver cream frequently to factory; follow recommended procedure in cleaning and steam sterilizing of milking machines.

Weedy Flavours.

Common cream-tainting weeds in Queensland are lesser swine cress (*Coronopus didymus*), Peppercress (*Lepidium* species), turnip weed or mustard weed (*Rapistrum rugosum*) and coral berry (*Rivina humilis*).

Prevention.—Complete removal of taint cannot be effected even in the factory, hence cream is usually second grade. Pasture management is the only means of prevention.

Cardinal Points in Cream Production.

Healthy, well-fed stock.

Abundant and pure water supply at milking shed.

Adequate supply of hot water for cleaning purposes.

Clean, near-sterile utensils.

Milking clean udders in clean bails; using clean hands.

Cool cream as low as possible, and keep cool.

Frequent delivery of cream to the factory.

Consult the district dairy officer, who will advise on any cream defect or on other points in dairy practice.

Let QUALITY be every dairy farmer's watchword.

The Aerial Transport of Feed for Floodbound Sheep.

G. R. MOULE, Director of Sheep Husbandry.

THE unreliable nature of the rainfall of the greater part of Queensland's sheep country is well known. For instance, districts whose average annual rainfall lies between 15 and 24 inches may receive as little as 6-8 inches in a year or as much as 12-15 inches in a single month. Generally the late summer rains (that is, those of January, February and March) are the most reliable and heaviest of the year. Winter rains are usually unreliable and light. Southern Queensland, however, has a more evenly distributed rainfall than the tropical areas since its winter rains, although less intense than summer falls, are fairly reliable.

Occasionally, as in the years 1891, 1906, 1918, 1941 and 1950, exceptionally heavy rains occur. Those in 1950 were of particular interest because they were preceded by a bounteous season in which the most widespread and heaviest rains ever recorded in the late spring and early summer occurred. These were followed by a series of five cyclones in late summer (early 1950) and further heavy falls in early winter, so by the end of June a large part of this country, which usually receives about 20 inches a year, had received more than 60 inches in the previous 18 months. By this time most of the inland rivers, which are characterised by a slow run-off, were full and the ground was saturated. Winter evaporation is low, so there was little chance of the ground drying out before early summer. Thus, when further heavy rains fell over south-eastern Queensland in July, severe flooding resulted, which became serious in the Condamine, Macintyre and Balonne River systems. The floods spread rapidly over the low-lying flats of the Western Darling Downs and Maranoa pastoral districts and on many properties sheep were isolated on small islets of land.

As the State's sheep population was below average, woolgrowers realised that it would be difficult to replace any animals lost in the floods. Moreover, many ewes were in lamb and some were carrying more than six months' wool. High prices were ruling for sheep and wool at the time, so woolgrowers decided to feed the isolated flocks on fodder dropped from the air.

Plate 69.

A View of Some of the Flooded Country in the Maranoa District.

Over 400,000 lb. of stock feed were dropped by one airline company alone, which undertook 60 flights, necessitating more than 300 hours' flying time.

In undertaking this work, some interesting problems associated with the aerial transport of feed to floodbound stock were encountered. The purpose of this article is to inform stock owners how aerial transport can be used most profitably under such circumstances.

GENERAL CONSIDERATIONS.

Throughout the operations D.C.3 aircraft were used. An aircraft is designed to fly at a certain maximum weight, referred to as the "all up weight," and for the D.C.3 this is about 26,950 lb. Therefore, planes of this type, which weigh about 16,500 lb., are capable of lifting a load of about 10,450 lb. Not all of this can be regarded as pay load (that is, the amount of stock food which can be carried on each flight) as the plane must carry sufficient petrol for the flight, the crew who fly it and the additional staff required to push the fodder out of the escape hatches.

Fuel consumption of D.C.3 freight planes varies with the strength and direction of the prevailing winds, the height at which the plane flies, and the number of times it has to attain that height from low altitudes during the course of its flight. The amount of petrol carried by the planes depends on the length and nature of the trip to be undertaken.

This means that the actual pay load decreases as the distance it has to be transported increases. During the operations described in this article, the planes carried an average of 6,500 lb. of feed each trip, but this ranged from 5,500 to 7,000 lb.

The flying time for each trip varied from 4 to 8 hours, with the average at about 6 hours. A flat rate of £50 per hour flying time was made for the charter of the planes, so the freight charge alone for the delivery of a load of feed to the average property was in the vicinity of £300.

These charges show the importance of using methods which will permit most efficient utilisation of the pay load available on every aircraft engaged on the work. The main factors to consider are the type of feed which is carried and the way in which it is packed.

SELECTION OF FEED TO BE CARRIED.

The feed should be chosen upon the following points:—

(1) Availability of the foodstuff. This can be determined from market reports.

(2) The feeding value of the foodstuff and its cost per food unit.

(3) The suitability of the food for the purpose, including its palatability and its bulk/weight ratio, which is important in handling.

The value of the feed to the sheep varies a good deal because of differences in composition. These include variations in protein, carbohydrate, and mineral contents, but an overall figure is more suitable for purposes of comparison. Food values for the feeds commonly used in Queensland are given as percentage ''food units'' in Table 1. ''Food unit'' is a term which considers all variations.

TABLE 1.

FOOD VALUES OF COMMON FOODSTUFFS.

Foodstuff.	Number of Food Units per 100 lb. of Foodstuff.
Concentrates—	
Maize, wheat, barley and sorghum grains, linseed meal, and cottonseed meal	77
" Nuts " (varies with brand—average figure only)	65
Oat grain	60
Roughages—	
Cereal chaff	40
Lucerne hay	40

As the foodstuffs vary considerably in food value, different amounts of each are required to maintain sheep. This is shown in Table 2, which gives the number of sheep fully maintained by a bag of food per day, as well as the amount required for the maintenance of 1,000 sheep per week based on 8 oz. of maize per head per day.

TABLE 2.

REQUIREMENTS OF VARIOUS FOODSTUFFS TO MAINTAIN SHEEP.

Foodstuff.	Ounces Equivalent to 8 oz. of Maize.	Pounds per Corn sack.	Sacks per Ton.	Number of Sheep fed at rate of 8 oz. of Maize (or Equivalent) per Head per Day from 1 sack.	Number of Pounds at 8 oz. of Maize (or Equivalent) per Head per Day, per 1,000 Sheep per Week.
Concentrates—					
Whole maize ..	8	160	14	320	3,500
Crushed maize ..	8	120	19	240	3,500
Wheat	8	175	13	350	3,500
Grain sorghum ..	8	156	14	312	3,500
Oats	10	130	17	208	4,375
Nuts	9·5	125	18	210	4,156
Roughages—					
Lucerne hay ..	15·5	*	..	..	6,781
Cereal chaff	15·5	**	..	..	6,781

* Lucerne hay is measured in bales. There are 70–80 lb. per bale (28–32 bales to the ton) and 72–82 sheep can be fed at the rate of 8 oz. of maize or equivalent per head per day from one bale.

** Cereal chaff is measured in chaff bags. They are about 84 lb. to the bag (about 27 bags to the ton), and about 87 sheep can be fed at the rate of 8 oz. of maize per head per day from the bag.

From this table it is seen that less of any of the concentrates listed is required to maintain 1,000 sheep for a week than is needed when feeding the bulky foods such as chaff and hay.

The relationship between the bulk and the feeding value of the various foodstuffs is important, as upon it depends the relative ease of handling in the aircraft and the manner of packing the feed for successful dropping.

These facts have important practical application, and Tables 3 and 6 have been prepared to show comparisons between the purchase price and costs of air freight for different foodstuffs required to provide 1,000 dry sheep with 8 oz. of maize (or its equivalent) per head per day for a week, at varying market rates and different distances of haulage.

SOME ASPECTS OF THE PAY LOAD.

A D.C.3 is capable of lifting a load of about 10,450 lb., the load being made up of the necessary petrol, crew members, and the pay load.

In assessing the weight of petrol which must be carried on any trip, it is assumed that the fuel consumption of a D.C.3 is about 80 gallons an hour. In addition, an extra 70 or 80 gallons (1 hour's flight) is allowed for emergencies. For short flights, however, this is not so, as the plane always carries a minimum of 350 gallons. The weight of a gallon of fuel is 7·2 lb., so the weight of the fuel is as follows:—

Number of Hours' Flight.	Gallons of Fuel Carried.	Weight of Fuel in lb.
2	350	2,520
3	350	2,520
4	400	2,880
5	480	3,456
6	550	3,960
7	700	5,040
8	700	5,040

TABLE 3.

COMPARATIVE COSTS PER 1,000 SHEEP PER WEEK FOR VARYING COSTS OF FEED (EACH SHEEP GIVEN EQUIVALENT OF 8 OZ. OF MAIZE PER DAY).

Foodstuff.	Pounds per 1,000 Sheep per Week.	Purchase Price per Ton.									
		£1	£2	£3	£4	£5	£6	£7	£8	£9	£10
		Cost per 1,000 sheep per week.									
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Concentrates—											
Maize	3,500	1 11 3	3 2 6	4 13 9	6 5 0	7 16 3	9 7 6	10 18 9	12 10 0	14 1 3	15 12 6
Wheat ..	3,500	1 11 3	3 2 6	4 13 9	6 5 0	7 16 3	9 7 6	10 18 9	12 10 0	14 1 3	15 12 6
Grain sorghum	3,500	1 11 3	3 2 6	4 13 9	6 5 0	7 16 3	9 7 6	10 18 9	12 10 0	14 1 3	15 12 6
Oats	4,375	1 19 1	3 18 2	5 17 3	7 16 4	9 15 5	11 14 6	13 13 7	15 12 8	17 11 9	19 10 10
Nuts	4,156	1 17 1	3 14 2	5 11 3	7 8 4	9 5 5	11 2 6	12 19 7	14 16 8	16 13 9	18 10 10
Roughages—											
Lucerne hay ..	6,781	3 0 7	6 1 2	9 1 9	12 2 4	15 2 11	18 3 6	21 4 1	24 4 8	27 5 3	30 5 10
Cereal chaff ..	6,781	3 0 7	6 1 2	9 1 9	12 2 4	15 2 11	18 3 6	21 4 1	24 4 8	27 5 3	30 5 10

In addition to the fuel, the plane carries five men—a pilot, a co-pilot, and three men to unload the fodder. It is usual to allow 200 lb. for each man in the plane; this covers, too, any extra gear which might be carried. The weight of the crew in this case would be 1,000 lb.

The pay load can thus be worked out for each flight distance. For example, for a 4-hour flight it is:—

$$10{,}450 - (2{,}800 + 1{,}000) = 6{,}570 \text{ lb.}$$

This, of course, varies, depending on the weather conditions at the time.

There is one other factor which must be considered. When concentrated grains are dropped they must be bagged. As explained later in the section on packing, for most successful dropping the weight of the bags is approximately 150 lb. per ton of grain. Therefore, for every ton of grain dropped to the sheep the actual weight of the payload is 2,390 lb. (that is, 2,240 + 150 lb.). This must be considered in Table 5, which shows the number of sheep which can be fed from one load. Of every 64 lb. of load, only 60 lb. is grain.

For instance, for a 4-hour flight the pay load is 6,570 lb., but the actual amount of grain carried is $\frac{6{,}570 \times 60}{64}$, which equals 6,159 lb.

Similarly, when nuts are dropped they are bagged in hemp bags which weigh about $1\frac{1}{2}$ lb. each. Each bag contains about 120 lb. of nuts, so there are about 19 to the ton. Thus for every ton of nuts dropped the actual weight of the load is about 2,270 lb. For instance, for a 4-hour flight the pay load is 6,570 lb., but the actual amount of nuts carried is $\frac{6{,}570 \times 120}{121.5}$, which equals 6,489 lb.

The weight of the roughages remains the same as the pay load, since the weight of the packing is negligible.

TABLE 4.

SHOWING THE RELATIONSHIP BETWEEN NUMBER OF HOURS OF FLIGHT AND CORRESPONDING WEIGHTS OF FOODSTUFFS CARRIED.

Hours of Flight.	Weight of Concentrates. in lb.	Weight of Nuts in lb.	Weight of Roughages in lb.
2	6,497	6,844	6,930
3	6,497	6,844	6,930
4	6,159	6,489	6,570
5	5,619	5,920	5,994
6	5,147	5,422	5,490
7	4,134	4,356	4,410
8	4,134	4,356	4,410

For example, 6,159 lb. of maize can be carried on a 4-hour flight. It takes 3,500 lb. to maintain 1,000 sheep for a week, so 1,760 could be maintained on this one load. Figures for other loads are shown in Table 5.

From information in Table 5 it is possible to work out values in Table 6.

By consulting Tables 3 and 6 it is seen that the overall costs—that is, cost of purchase and aerial transport of feeding concentrates—are far less than those incurred when feeding roughages. Consider, for

TABLE 5.

Number of Sheep (to the nearest 10) which can be fed For One Week on One Load of Various Foodstuffs at the Rate of 8 oz. of Maize per Head per Day (or its equivalent) Carried Various Distances.

Foodstuff.	Pounds per 1,000 Sheep per Week.	Number of Hours of Flight.						
		2	3	4	5	6	7	8
		Number of Sheep Fed.						
Concentrates—								
Maize ..	3,500	1,860	1,860	1,760	1,610	1,470	1,180	1,180
Wheat ..	3,500	1,860	1,860	1,760	1,610	1,470	1,180	1,180
Grain sorghum	3,500	1,860	1,860	1,760	1,610	1,470	1,180	1,180
Oats	4,375	1,490	1,490	1,410	1,280	1,180	950	950
Nuts	4,156	1,650	1,650	1,560	1,420	1,300	1,050	1,050
Roughages—								
Lucerne hay ..	6,781	1,020	1,020	970	880	810	650	650
Cereal chaff ..	6,781	1,020	1,020	970	880	810	650	650

TABLE 6.

Comparative Freight Charges (to the nearest £) on Various Foodstuffs for 1,000 Sheep for One Week Carried Various Distances.*

Foodstuff.	Pounds per 1,000 Sheep per Week.	Number of Hours of Flight and Corresponding Cost of Trip.						
		2 £100	3 £150	4 £200	5 £250	6 £300	7 £350	8 £400
		Cost per 1,000 Sheep per Week. (£)						
Concentrates—								
Maize	3,500	54	81	114	155	204	297	339
Wheat ..	3,500	54	81	114	155	204	297	339
Grain sorghum	3,500	54	81	114	155	204	297	339
Oats	4,375	67	101	142	195	254	368	421
Nuts	4,156	61	91	128	176	231	333	381
Roughages—								
Lucerne hay ..	6,781	98	147	206	284	370	538	615
Cereal chaff ..	6,781	98	147	206	284	370	538	615

* Based on a speed of 160 m.p.h. and £50 per hour flying for charter.

example, the case of a woolgrower who wished to feed 5,000 young ewes marooned on a small part of a flooded property in the Dirranbandi district about 320 air miles from Brisbane. This would involve a non-stop return journey of about 640 miles, which would mean a minimum of four hours' flying. In addition, depending on the winds, the plane may have to make a circuit or two over the airport, both on taking off and before landing. It may also have to remain over the "target area," where the fodder is dropped, for between 45 and 60 minutes, depending on the rate at which the feed can be "unloaded." This means that a single flight may take between 5 and 5½ hours.

If maize is fed,, sufficient to feed 1,610 sheep for 1 week (see Table 5) could be carried on one flight. Thus three flights would have to be made to carry the 17,500 lb. of maize required to feed 5,000 sheep for a week. Supposing this would take a total of 16 hours' flying time, the cost of the aerial transport would be £800. In addition, the purchase price of the maize would probably be about £240, making the total cost about £1,040.

If lucerne hay is fed, 33,900 lb. would have to be carried to give the sheep a ration equal in food value to that provided by 8 oz. of maize per head per day. This would necessitate six flights, involving about 32 hours' flying time, and transport alone would cost about £1,600. When the purchase price of the lucerne hay, which would approximate £275, is added, the overall cost of feeding lucerne hay would be £1,875. These calculations show a balance of £835 in favour of maize. If the work had to be continued for three weeks, about £2,500 would be saved by feeding maize, or some comparable concentrate, instead of lucerne.

A comparison of the costs per head per week for feeding a maintenance ration of a concentrate grain against those incurred for feeding a maintenance ration of lucerne is as follows:—

	s.	*d.*
Cost of purchase* and aerial transport of maize per head per week	4	2
Cost of purchase* and aerial transport of lucerne hay per head per week	7	6
Excess cost of lucerne hay over maize per head per week	3	4

* The ruling market prices at the time were accepted as the purchase price.

The majority of woolgrowers fed lucerne to their sheep during the recent floods. Although there are probably particular reasons for this associated with the difficulties of packing and distribution of the maize, over £8,000 would have been saved had maize or some comparable grain been used.

Plate 70.

Loading Baled Lucerne Hay Into a Freight Plane.

PACKING OF THE FEED.

It must be recognised that an important principle in the aerial transport of stock feed is to reduce the weight of the containers to a minimum, so that the maximum amount of foodstuffs can be carried. The planes spend very little time over the actual target area where the food is dropped. During the drop they fly at about 110 m.p.h. and would pass over a target area 10 chains long in about 4 seconds. This means that the staff responsible for pushing the fodder out of an open doorway have very little time in which to work. After each drop, the plane has to climb to make its circuit before coming in again to make its next drop. This may take almost five minutes, and unless a large quantity of feed can be dropped each time the plane is over the target area the cost of the actual unloading becomes quite high.

Plate 71.

Unloading Baled Lucerne Hay from a Freight Plane.

This suggests that it is preferable to make each pack of feed as heavy as possible, so that the maximum amount can be pushed out each time the plane makes its run over the target. However, there is a drawback in doing this. The force with which a bag of feed strikes the ground depends upon its weight and the speed at which it is travelling. The speed depends largely upon the height from which it is dropped. In practice the pilots found that 150 feet was the best height at which to fly the planes for accurate dropping. Often there was only a very small area of dry land on which to drop the bags. If pilots were lower than 150 feet they passed over the target too quickly; if they were higher, accurate dropping was more difficult because of the unwieldy shape of the pack, its forward velocity, and the greater effect of the wind. In addition, when flying high the bags gained too much speed in their fall and burst more easily.

Bags are used when grains are being transported and the relationship between the weight of the bags and their contents has been determined for packs of different types and weights. In these calculations, double bagging (one cornsack and one chaff bag) was allowed for packs of up to and including 60 lb., and treble bagging (two cornsacks and one chaff bag) was allowed for packs of over 60 lb. Allowing 2½ lb. for the weight of a cornsack and 1½ lb. for the weight of a chaff bag, the relationships are as follows:—

Net Weight of the Pack.	Number of Packs per ton.	Bags Used Per Ton of Grain.	Weight of Bags Per Ton of Grain.
Lb.			Lb.
40	56	112	224
50	45	90	180
60	37·5	75	150
70	32	96	208
80	28	84	182
90	25	75	162½

Some difficulty was experienced in dropping maize during the operations, because a large number of bags burst and their contents were so scattered over the boggy ground that the sheep were unable to recover the grain. Investigations revealed that the packs were too heavy, and in an experiment conducted by the Department of Agriculture and Stock in conjunction with Australian National Airways Pty. Ltd., it was found that very little maize was lost if 60 lb. was placed in double bags—that is, in a cornsack and a chaff bag. Almost half the maize was lost through bags bursting if 70 lb. was packed similarly.

Because 60 lb. packs will land safely if correctly packed, and because the relationship between the weight of the bags and their contents is economical, it is recommended that they should be used in the event of further drops being made. On striking the ground the grain tends to behave somewhat like a liquid and it is necessary to pack it loosely to allow it to spread. When making 60 lb. packs, room for a little under two bushels of maize should be left in the cornsack. The cornsack is then put inside a chaff bag, the mouth of which is sewn in the usual fashion. The inner bags may burst when the pack strikes the ground, but the outer chaff bags prevent the maize from spilling.

Baled lucerne hay has an advantage over maize in that it is easy to pack. Double baling, with the second pair of wires a little looser than the first pair, is all that is required. Lucerne hay maintains a very favourable relationship between the weight of the feedstuff and the weight of its containers, but owing to the high freight charges in relation to the low food value it is the most expensive feed to use.

GROUND ORGANISATION FOR FEEDING FLOODBOUND SHEEP.

The ground organisation is greatly simplified if the sheep are "in hand" and under good control. The easiest way of feeding concentrate grains is in troughs, and suitable ones can be made by stretching bags on two wires. The hardest dry place available should be selected for feeding and it should be as near as possible to the place where the feed can be dropped.

The dropping areas should be indicated by fires, which also provide a smoke drift to indicate the direction and force of the wind. It is preferable to select as large a dry patch as possible for the dropping area. The drops are made into the wind, and a long, narrow strip of dry land is only suitable if the wind is blowing the right way.

It is often difficult to control the food intake of the sheep when trough feeding animals that are marooned well away from yards. Good dogs are of considerable assistance and some sheep can be worked onto the troughing, and moved off to another ''camp'' after they have fed. The most satisfactory way of arranging this work is to place sufficient feed in the troughs for the number of animals that can eat at them conveniently, allowing one running foot of trough length for each animal. If the troughs are 60 feet long there would be 120 running feet of troughing and 120 sheep could feed at them conveniently at one time. If a ration of 8 oz. of maize per head, or its equivalent, were fed each day, 60 lb. of maize could be put in the trough and 120 sheep allowed on to it. When they have eaten the allotted food they can be moved off, more food put out, and more sheep brought in. Care should be taken to bring the sheep on to the end of the trough and not up to the side. By doing this, the animals distribute themselves along each side of the trough, and do not crowd on one side.

Trough feeding makes a great deal of work, and, provided the sheep are not within a couple of months of lambing, it can be overcome by weekly or by bi-weekly feeding. Sufficient feed to last all the sheep a week or half a week is put out in the troughs and the animals are allowed to eat what they require when they like. This method has proved eminently successful with drought feeding, but if wheat is being fed under these conditions, it is preferable ''to roll'' it.

Plate 72.

A Typical Dropping Area. Note the small area and the bales lying on the ground.

Lucerne hay has a distinct advantage over the concentrate grains for feeding under these conditions. The bales can be put out easily and the animals allowed to eat as they wish. This is likely to be an important aspect in the choice between lucerne and the more concentrated feeds where labour is short and/or the conditions particularly difficult. Even if lucerne hay is preferable for these reasons, it is still expensive.

If it is hard to get the sheep in hand, and if there is a large enough area of bare hard ground, the feeding of nuts from the air is worthy of consideration. Because of their larger size, the nuts can be picked up more easily by the sheep even if the ground is damp. They constitute an admirable food for sheep which are unattended and for this purpose they are most suitably packed in large paper or hempen bags which burst on striking the ground and allow the nuts to scatter.

Plate 73.

A Typical Dropping Area on which 60 lb. Packs of Grain Have Been Dropped.

The age and class of the sheep which are floodbound influence the method of feeding. It is sufficient to keep dry or young sheep alive, whereas ewes which are heavy in lamb must be fed a ration sufficient to prevent the occurrence of pregnancy toxaemia. It is well known that dry sheep will not be seriously affected by 72 to 96 hours of starvation and that they can live for a considerable time even after their food intake has been greatly reduced. In drought feeding it is possible to keep sheep alive on 8 to 9 oz. of maize (or its equivalent) per head per day. When the sheep are entering the drought, 6 oz. per head per day is usually sufficient, as the animals live to some extent on their body reserves, which can also be utilised when feeding floodbound sheep. Because of the high cost of transporting feed, it is cheaper to let the dry sheep lose some weight while they are being fed, rather than attempt to maintain their weight. This means it would be advisable when

Plate 74.

A Dropping Area Near a Set of Sheep Yards Where Floodbound Sheep and Horses are being Fed.

Plate 75.

Sheep Confined on the Banks of a Dam, Close to a Homestead. There are about 10,000 sheep in the mob. Some of them have been driven into the water to make sufficient room for the dropping of fodder. The name on the homestead roof permits immediate identification.

Plate 76.

A Dirranbandi Homestead Surrounded by Flood Water. The dropping area is in the top right hand corner of the picture.

handling dry sheep to find the minimum ration which will keep the sheep alive. This may be as low as 6 oz. of maize (or its equivalent) per head per day, and could be increased to 8 or 9 oz. per head per day if necessary. Ewes which are heavy in lamb should be fed at the rate of 12 oz. of maize (or its equivalent) per head per day from the commencement. Finely ground limestone (1 per cent. by weight) should be added to grains.

Table 7 shows the weights of various foodstuffs equivalent to various amounts of maize.

TABLE 7.

WEIGHTS OF VARIOUS FOODSTUFFS EQUIVALENT TO VARIOUS AMOUNTS OF MAIZE.

Concentrates—	Oz.	Oz.	Oz.	Oz.	Oz.
Maize	3·0	6·0	8·0	9·0	12·0
Wheat	3·0	6·0	8·0	9·0	12·0
Grain sorghum ..	3·0	6·0	8·0	9·0	12·0
Oats	4·0	8·0	10·0	12·0	16·0
Nuts	3·75	7·5	9·5	11·25	15·0
Roughages—					
Cereal chaff	6·0	12·0	15·5	18·0	24·0
Lucerne hay ..	6·0	12·0	15·5	18·0	24·0

If the feeding is continued for some time, a definite tail will develop in the flock. This is because some sheep are not getting enough to eat, and as they get weaker the stronger ones crowd them out more and more. It may be advisable to draft these animals off and feed them a little

extra. Maize is one of the best feeds for strengthening weak sheep quickly, but because of the high fibre content of oats they are useful as a source of warmth during cold weather.

It is far better to feed a limited number of flocks properly than to try to feed too many. In the latter case the sheep would be improperly fed and may still die of starvation.

Station homesteads are often difficult to locate and to identify from the air. During severe floods many of the natural landmarks are submerged. While houses are often easy to see from planes flying at a fair height, they can be difficult to detect if surrounded by timber and if the plane is only a few hundred feet above the ground. For these reasons it is advisable to have the name of the property painted on the roof of the woolshed or some other conspicuous building.

A lot of time, trouble, and expense can be saved if woolgrowers in a neighbourhood co-ordinate their orders so that all the properties in one area can be served by one airline company. Failure to do this often means unnecessary duplication of planes and flights, and throws an extra burden on the freight sections of air transport companies which are already meeting additional demands upon their services as a result of the floods.

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[*Continued from page* 93.]

1951 SHOW DATES.

May—continued.

Biloela	24, 25 and 26
Crow's Nest	25 and 26
Kalbar	26
Maryborough	31, June 1 and 2
Wowan	31, June 1 and 2

June.

Boonah	1 and 2
Childers	4 and 5
Bundaberg	6 to 9
Mt. Morgan	7, 8 and 9
Lowood	8, 9 and 11
Gin Gin	11 and 12
Gladstone	14, 15 and 16
Toogoolawah	15 and 16
Rockhampton	20 to 23
Kilcoy	22 and 23
Mackay	26, 27 and 28
Esk	29 and 30
Proserpine	29 and 30

July.

Bowen	4 and 5
Nambour	5, 6 and 7

July—continued.

Rosewood	6 and 7
Ayr	6 and 7
Townsville	9 to 12
Laidley	13 and 14
Redlands	13 and 14
Ingham	13 and 14
Gatton	19, 20 and 21
Innisfail	20 and 21
Woodford	20 and 21
Cairns	24, 25, 26 and 27
Pine Rivers	30
Atherton	30, 31 & August 1

August.

Tully	3 and 4
Brisbane	4 to 11
Redcliffe	17 and 18
Wondai	31 & September 1

September.

Canungra	1
Kandanga	3 and 4
Cherbourg	7 and 8
Beenleigh	14 and 15

ANIMAL HEALTH

Milk Fever of Cattle.

Prepared in the Division of Animal Industry.

MILK fever is a disease of dairy cows, especially those on their third or a later calf and still producing at a high level. It occurs at or near the time of calving, the great majority of cases being seen within 12 to 72 hours after that event, though some cases may not occur for up to ten days afterwards. Occasionally cases do occur in cows shortly before or during calving. The disease is not well named as it is not characterized by a rise in body temperature, which in fact may be below normal. The name is a carry-over from the days when the disease was thought to be an udder condition.

Cause.

The commonly accepted theory as to the cause of milk fever is that it is due to grave lack of the mineral calcium in the blood stream at the time of calving. This is indicated by the low level of calcium found in the serum of the blood of cows suffering from milk fever. Even with normal calving there is an appreciable drop in the serum calcium level, but this soon returns to normal. In cases of milk fever, the drop is more pronounced and does not rise again on its own account. The drop in calcium content of the blood stream at calving time is not to be wondered at when it is realized that half a gallon of colostrum (first milk) contains as much calcium as is present in the entire blood stream at any one time.

Symptoms.

The following are the main symptoms noticed in a cow suffering from milk fever: Firstly, there is complete loss of appetite; the cow stands by herself, has a dejected appearance, and shows no interest in her calf. If moved she appears stiff and lacks full control over the hindquarters. Eventually she goes down and is unable to rise again. At first the cow lies on the brisket with legs projecting stiffly, and, if left, will go over on her side and become relaxed and comatose. A very common attitude in which the cow is seen when down is with the head turned round towards the flank. In other cases the head is kept in the forward position but the neck has a pronounced kink. The temperature remains normal or may be slightly sub-normal. Muzzle and eyes are dry and the affected animal does not respond to any stimulus.

In typical milk fever, the overall picture is one of depression of consciousness with muscular paralysis. There may be a brief period early in the course of the case during which the animal shows excitement, but what may be likened to sleep sets in fairly quickly thereafter. Cases of milk fever which are complicated by a low level of blood magnesium do occur. Here the picture may be one of excitement and restlessness, but such cases are rare.

The mortality rate in untreated cases is very high, death occurring in from a few hours up to two or three days. The closer to calving that symptoms appear, the more acute is the disease. With treatment, the mortality rate is very low and then deaths are usually due to complications. For best results treatment should be carried out early, preferably within 6 to 8 hours of the first appearance of symptoms.

Treatment.

Treatment is aimed at correcting the deficiency of calcium in the blood stream by one of two methods—

(1) The actual addition of calcium as calcium salts by injection;

(2) The prevention of further loss of calcium from the blood stream to the milk by udder inflation.

The inflation treatment was much used until recent years, but has now been largely superseded by the injection treatment. Before commencing to inflate the udder it should be wiped with a clean damp rag, and then a fresh towel should be placed under the udder to prevent contamination from the soil. The beast should then be propped up on its breastbone in as natural a position as possible, taking care that the hind legs are in a normal position and not causing undue pressure on the udder. In very advanced cases, this may not always be possible, but it should be attempted.

Each quarter is inflated firmly and the teats are tied off at the base with clean tapes to prevent the escape of air. The udder should then be massaged gently to distribute the air throughout its substance. The tapes should be removed about half an hour after they are put on. If no improvement is noted after three hours, inflation should be repeated.

The most undesirable after-effect that may follow treatment by udder inflation is mastitis. To avoid this the following precautions should be observed:—

(1) The teat syphon used should be sterilized thoroughly before use by boiling.

(2) Every precaution against the teat syphon coming into contact with any contamination should be taken during inflation; if that happens the syphon should be immersed in boiling water before being used again, or a spare brought into use.

These precautions are against the possibility of introducing any infection into the healthy udder.

(3) If a quarter of the udder of a cow being treated with milk fever is affected with mastitis, or has been so affected at any time, that quarter should be the last inflated; and, following use on that quarter, the teat syphon must be sterilized thoroughly by boiling before being used again.

The drug used for injection is calcium borogluconate, which is fairly soluble in water and non-irritant. The recommended dose of this drug is 3 oz. added to one pint of water (which makes a 15 per cent. solution). The solution should be brought to the boil and then allowed to cool to blood heat before use. If experienced with injections into the jugular vein of the neck, half of this solution can be injected into the vein and the remaining half under the loose skin at a number of sites on either side of the neck. The injection of all the solution in

one place should not be attempted. Lumps formed under the skin as the result of the injections should be massaged without delay so as to disperse the fluid through the surrounding tissues. If the drug cannot be injected into the vein, a stronger solution may be used (3 oz. to half a pint of water) and injected under the skin in various places. For the more acute and urgent cases, the administration into the vein is preferable, as a much quicker response is obtained.

Care should be taken to sterilize syringes or injection apparatus, needles, &c., and the sites of injection can be swabbed with an antiseptic such as tincture of iodine or methylated spirits.

After injection into the vein in cases of typical milk fever, response is often spectacular, and affected cows may get on their feet within ten minutes. However, cases which have been down a long time may take much longer. Response to administration under the skin usually takes about two to four hours. In most cases the recovery is permanent, but an occasional case may relapse within 12 hours to two days. In such cases the treatment must be repeated.

Some cows are more susceptible to milk fever than others, and, in the case of a known milk fever subject, preventive treatment may be decided upon, the injection of calcium borogluconate being carried out immediately following calving.

There are now on the market several specially prepared outfits for intravenous or subcutaneous injections in the treatment of milk fever. These are obtainable from most chemists or veterinary supply houses. They are readily assembled and sterilized for quick use. They include what is known as a flutter valve apparatus. This type has proved quite efficient and has the advantage of not requiring any very special size or shape of bottle.

Calcium borogluconate is dispensed by chemists in packets of $2\frac{1}{2}$ oz., which was at one time considered a sufficient quantity for treatment of a case of milk fever. The tendency nowadays is to use the larger dose of 3 oz. and even up to 4 oz. The drug is at present available also in the form of a solution which is ready for immediate use, this having obvious advantages.

Whatever the method of treatment adopted, it is advisable to cover the animal with a rug. In no circumstances should the beast be drenched, as, because of the paralysis extending to the throat, the cow is unable to swallow, and the drench may enter the lungs and set up pneumonia.

After the treated cow gets to her feet, it is advisable that she be well cared for during the next day or two. No milk should be withdrawn from the udder for at least 12 hours after the cow has risen, and only small quantities of milk should be drawn off at intervals during the next 24 hours. The diet should be restricted for two to three days with a view to keeping milk production down to a minimum. Management along these lines will do much to safeguard against a relapse.

GULF CATTLE ARTICLE.

The article on "Beef Cattle Production on Some of the Gulf Watersheds," by Mr. J. C. J. Maunder, will be concluded in a subsequent issue of the Journal.

Warts in Cattle.

A. K. SUTHERLAND, Animal Health Station, Yeerongpilly.

WARTS are the result of infection of the skin with an extremely minute organism, known as a virus. The infection causes an excessive growth of skin tissue, and can be responsible for financial loss. This loss is brought about by—

(*a*) loss of condition and stunting of seriously affected calves;

(*b*) reduction in the value of hides;

(*c*) reduced sale value, particularly of pure-bred stock.

Warts are common in calves and yearlings, and occasionally cows are affected on the udder and teats.

The disease is contagious, and infection probably occurs when small abrasions of the skin come in contact with warty animals or with fences, buildings, rubbing posts, or other structures that affected animals have touched. To prevent the disease it is therefore important that affected animals be isolated. This is best accomplished by moving the healthy calves to clean pens or paddocks.

Warts are most common on the head, neck, and shoulders. Other parts of the body are occasionally affected. The infections usually commence as small nodular growths, which later develop rapidly into horny cauliflower-like masses up to several inches in diameter (Plate 77). Some calves develop one or two small warts and are thereafter immune, whereas in other calves the growths enlarge and spread until perhaps most of the head and the neck are covered with large ugly growths. The latter is particularly likely to occur in calves that are overcrowded or suffering from malnutrition or worm infestation.

Treatment.

Calves with warts always eventually clear up even if no treatment is applied. However, natural recovery may take a long time, so some treatment should be given to hasten it.

Many warts can be removed simply by clipping them off close to the skin with clean, sharp, curved scissors. The cut surface bleeds for a time, but this is of no consequence unless the growths are very large. The stump should be treated with tincture of iodine, glacial acetic acid or a caustic pencil.

This method of surgical removal cannot be applied when a large area of the calf's skin is involved. Nevertheless, a surprising number of warts can be cut off without causing any ill effects. It has been stated that when a few large warts are cut off the development of immunity and the tendency to recovery are accelerated, but in view of the fact that, in time, the growths disappear without any treatment, it is difficult to verify this.

Another method of removing warts is to tie a ligature of linen thread or catgut tightly round the base of the wart and tighten it every day or so until the growth sloughs off. This method should be used for large growths.

A third method, which has been used with some success, is to paint the warts daily with castor oil.

If the calves are suffering from malnutrition or worm infestation, their chance of developing immunity and so recovering from warts will be increased if the feeding is improved and worm infestation is treated by drenching with phenothiazine.

Prevention.

It is important to remember that warts are contagious and that every wart contains a virus that can infect another calf. Thus, if only a few calves are affected, they should be isolated and treated as described. Prompt detection of cases and removal of warts will limit the spread of infection.

As with most infectious diseases, some animals have a natural immunity, so in some herds the spread of the disease may be limited. However, it is impossible to know the extent of natural immunity in a herd until an outbreak has run its course, so it is wise to adopt preventive measures.

A vaccine has been used for both treatment and prevention of warts. Remembering the tendency of the disease to clear up spontaneously, the results obtained by subcutaneous injection of formolised vaccine have not been successful and the procedure cannot be recommended as an efficient preventive.

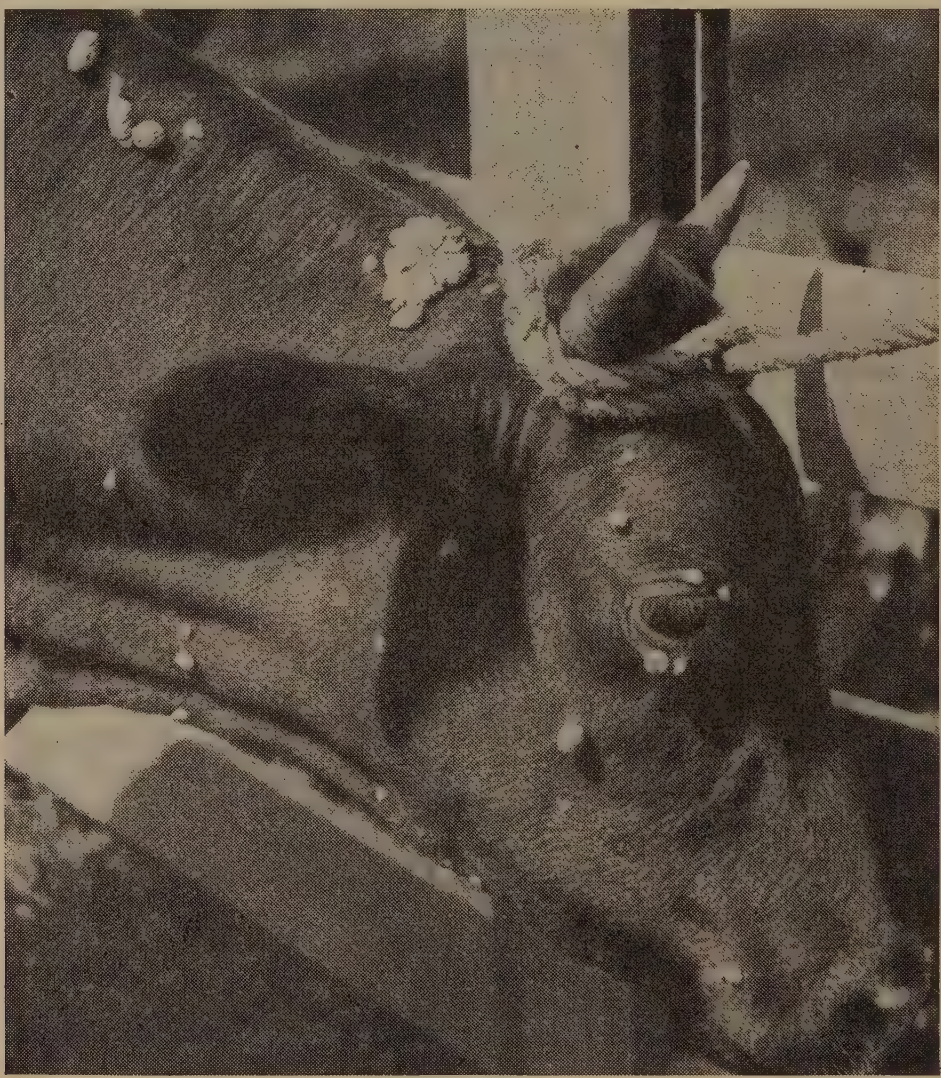
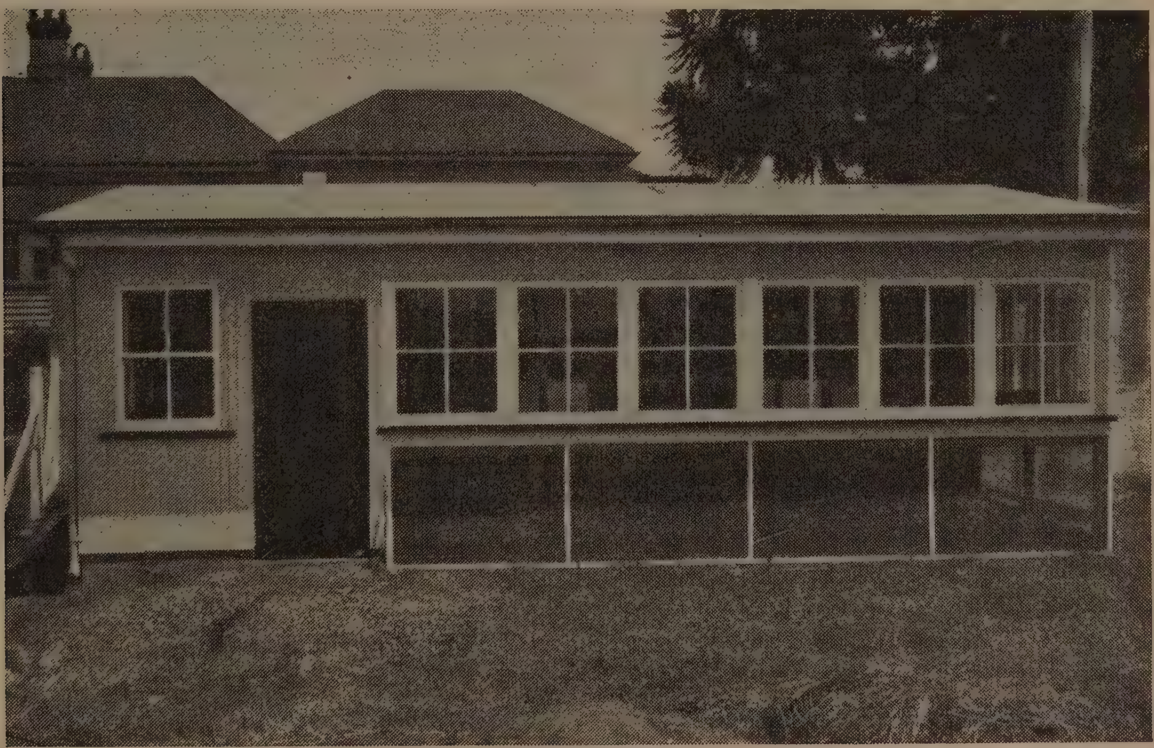


Plate 77.

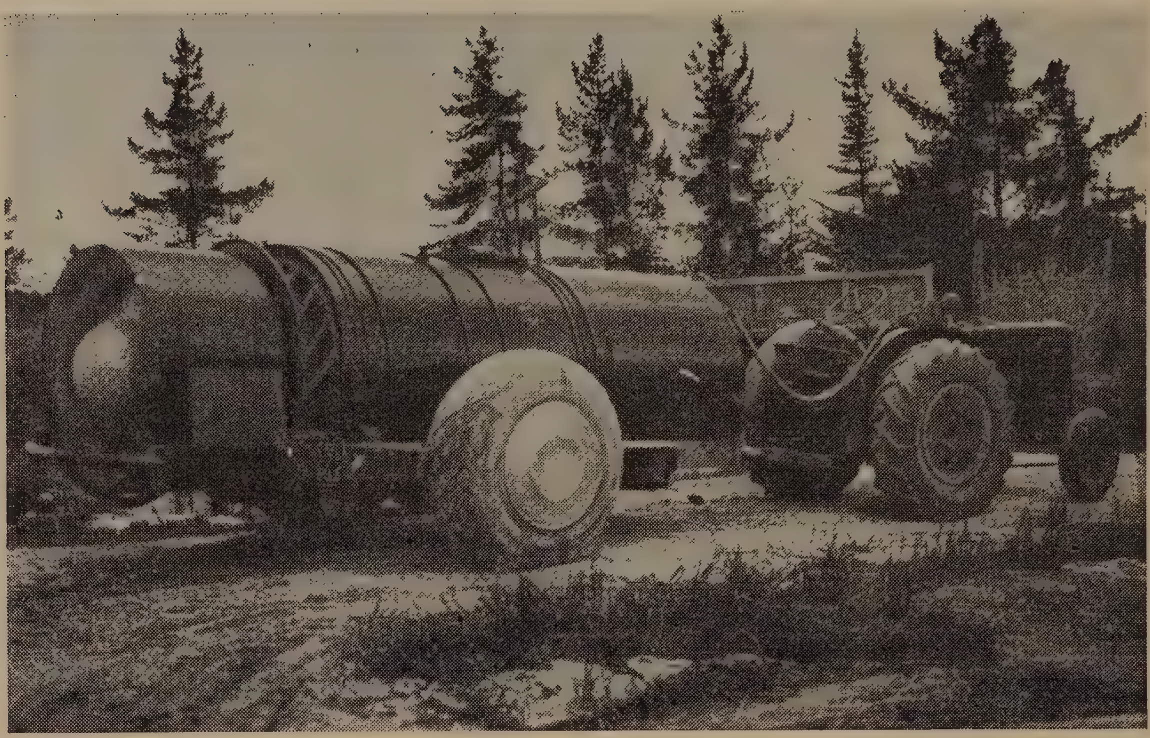
Warts on the Head and Neck of a Calf.

TUBERCULOSIS-FREE CATTLE HERDS (AS AT 15th JANUARY, 1951).

Breed.	Owner's Name and Address of Stud.
Aberdeen Angus	The Scottish Australian Company Ltd., Texas Station, Texas
A.I.S.	F. B. Sullivan, "Fermanagh," Pittsworth D. Sullivan, "Bantry" Stud, Rossvale, *via* Pittsworth W. Henschell, "Yarranvale," Yarranlea Con. O'Sullivan, "Navillus Stud," Greenmount H. V. Littleton, "Wongalea Stud," Hillview, Crow's Nest J. Phillips and Sons, "Sunny View," Kingaroy Sullivan Bros., "Valera" Stud, Pittsworth Reushle Bros., "Reubydale" Stud, Ravensbourne
Ayrshire	L. Holmes, "Benbecula," Yarranlea J. N. Scott, "Auchen Eden," Camp Mountain
Friesian	C. H. Naumann, "Yarrabine Stud," Yarraman J. F. Dudley, "Pasadena," Maleny
Jersey	W. E. O. Meier, "Kingsford Stud," Rosevale, *via* Rosewood J. S. McCarthy, "Glen Erin Jersey Stud," Greenmount J. F. Lau, "Rosallen Jersey Stud," Goombungee G. Harley, Hopewell, Childers Toowoomba Mental Hospital, Willowburn Farm Home for Boys, Westbrook F. J. Cox and Sons, "Rosel" Stud, Crawford, Kingaroy Line R. J. Browne, Hill 60, Yangan P. J. L. Bygrave, "The Craigan Farm," Aspley



Fruit Fly Control.—This field insectary recently built at Toowoomba is being used by Departmental entomologists who are making an intensive study of fruit flies.



Orchard Spraying Equipment.—This large unit is shown in operation spraying for pest and disease control in a Stanthorpe orchard.

ASTRONOMICAL DATA FOR QUEENSLAND.

MARCH, 1951.

Supplied by W. J. NEWELL, Hon. Secretary of The Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			MINUTES LATER THAN BRISBANE AT OTHER PLACES.					
Day.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	5·41	6·20	Cairns	32	26	Longreach ..	36	34
6	5·44	6·15	Charleville	27	27	Quilpie	35	35
11	5·46	6·10	Cloncurry	52	47	Rockhampton ..	11	9
16	5·49	6·04	Cunnamulla ..	29	29	Roma	17	17
21	5·52	5·59	Dirranbandi ..	19	19	Townsville ..	26	22
26	5·54	5·53	Emerald	20	18	Winton	42	38
31	5·57	5·48	Hughenden ..	36	33	Warwick	20	18

TIMES OF MOONRISE AND MOONSET.

At Brisbane.

Day.	Rise.	Set.
	p.m.	p.m.
1	11·16	12·56
2	..	2·02
	a.m.	
3	12·18	3·02
4	1·24	3·35
5	2·33	4·40
6	3·40	5·19
7	4·44	5·53
8	5·45	6·25
9	6·44	6·55
10	7·42	7·25
11	8·39	7·56
12	9·36	8·30
13	10·33	9·07
14	11·30	9·49
	p.m.	
15	12·26	10·35
16	1·19	11·27
17	2·08	..
		a.m.
18	2·53	12·23
19	3·33	1·20
20	4·09	2·20
21	4·43	3·19
22	5·14	4·19
23	5·45	5·18
24	6·18	6·20
25	6·53	7·23
26	7·32	8·29
27	8·18	9·38
28	9·11	10·47
29	10·11	11·55
		p.m.
30	11·17	12·57
31	..	1·52

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

Charleville 27; Cunnamulla 29; Dirranbandi 19;
Quilpie 35; Roma 17; Warwick 4.

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Day.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	30	9	46	24	21	0	54	26
6	26	14	42	29	17	4	49	33
11	14	25	30	41	5	16	34	48
16	8	30	24	45	0	21	25	54
21	14	25	30	41	5	16	34	47
26	27	13	43	28	18	3	50	32
31	29	10	44	24	19	0	52	27

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	56	3	68	32	52	18	46	4
3	57	2	69	32	53	17	47	3
5	51	9	65	36	49	22	42	9
7	40	21	57	44	42	29	33	18
9	28	32	50	53	34	38	24	28
11	18	43	42	59	27	45	16	36
13	8	51	36	64	21	50	8	43
15	2	56	33	67	17	53	3	46
17	2	55	33	67	17	52	3	45
19	9	51	37	64	21	50	8	43
21	19	42	42	59	27	44	17	36
23	30	31	51	51	35	36	25	26
25	42	19	58	43	43	28	35	17
27	53	7	67	35	50	21	44	8
29	57	2	69	32	53	17	47	3
31	52	4	66	33	50	19	43	5

Phases of the Moon.—New Moon, 8th March, 6.50 a.m.; First Quarter, 16th March, 3.40 a.m.; Full Moon, 23rd March, 8.50 p.m.; Last Quarter, 30th March, 3.35 p.m.

On 21st March at 8 p.m. the Sun will cross the equator on its apparent journey from south to north (Equinox). On this date the Sun will rise and set at true east and true west, respectively, viewed from all places on earth except from the Poles. At these points the Sun will neither rise nor set but make a complete journey round the horizon. On the 9th and 23rd the Moon will rise and set approximately at true east and true west respectively.

Mercury.—A morning object at the beginning of the month, in the constellation of Aquarius, when it will rise ¾ hour before the Sun. On the 11th it will be in line with the Sun, after which it will pass into the evening sky. By the end of the month, in the constellation of Aries, it will set ¾ hour after sunset.

Venus.—At the beginning of the month, in the constellation of Pisces, will set 1¼ hours after the Sun and for the next few months will be a conspicuous object in the western evening sky. By the end of the month, in the constellation of Taurus, will set 1 hour 35 minutes after the Sun.

Mars.—Now passing out of the evening sky. In the constellation of Pisces, at the beginning of the month will set 1 hour after the Sun, but by the end of the month will set only ½ hour after sunset. On the 9th the Moon will pass close to this planet.

Jupiter.—Also rapidly passing out of the evening sky, setting only ½ hour after sunset at the beginning of the month and being in line with the Sun on the 11th.

Saturn.—Reaches a point opposite the Sun on the 20th and is thus favourably placed for observation, being visible approximately from sunset to sunrise. On the 23rd the Moon will pass close to Saturn.

Eclipse.—On 8th March there will be an annular eclipse of the Sun but it will not be visible from Queensland.

THE CONSTELLATIONS.

Capricornus (The Sea-Goat) is a somewhat inconspicuous constellation situated along the Zodiac next to Sagittarius. It is supposed to represent the animal into which Pan was changed to allow him to escape from the Giant Typhon. It is important because it gave the name to the Southern Tropic—The Tropic of Capricorn. When this designation was given the Sun was in the Constellation of Capricorn when it reached its maximum angle south of the equator and shone directly over the Tropic of Capricorn. Owing to precession, however, when the sun reaches its maximum angle south of the equator it is now in the Constellation of Sagittarius. Though there are no bright stars in the group, it nevertheless contains some interesting objects for the amateur astronomer. Alpha is a naked-eye pair—not a binary, but two stars at varying distances almost in line. One star is 1,600 light years away and the other 108 light years. Each star, however, has a companion. Beta is also a double, and a line from Alpha through Beta meets a group of 3 stars—Pi, Omicron and Rho—all of which are doubles.

Greis (The Crane or Stork) is a modern constellation. The resemblance to a long-necked bird is imagined from the line of stars running from Beta to Gamma. Along this line are two naked-eye pairs, Mu and Delta. Pi, which lies in the centre of the triangle formed by Alpha, Beta and Delta, is a double.

Pisces Australis (The Southern Fish) contains the very bright star, Fomalhaut, and the doubles Beta, Gamma and Delta.

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Preparing for a Dry Spell. Harvesting Ensilage in the Boonah District.

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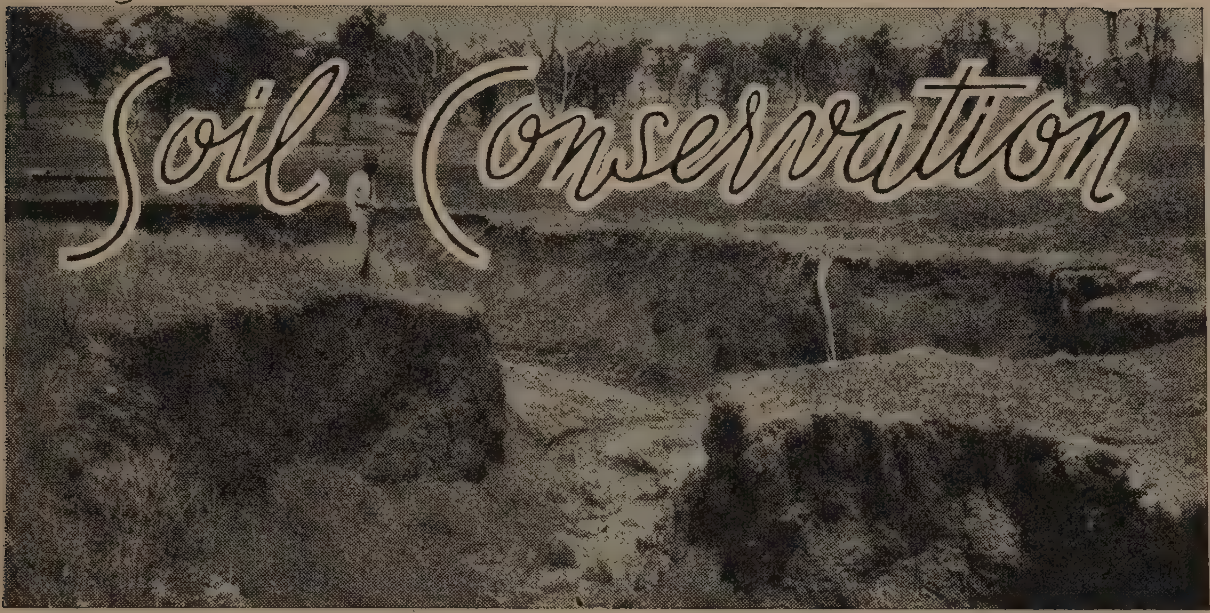
Contents



Soil Conservation in Queensland.

7. The Prevention and Control of Gully Erosion.

J. E. LADEWIG, Senior Soil Conservationist, and A. F. SKINNER, Soil Conservationist.

GULLY erosion is an advanced symptom of the misuse of land and is usually due to the concentration of the resultant excessive and uncontrolled runoff in either natural or artificial drainage depressions from which protective vegetation has been either partly or wholly removed (Plate 79).

Plate 79.

This Gullied Area was a Stable, Well-vegetated Drainage Line Thirty Years Ago.

This form of erosion normally develops either on or below land on which increased runoff has been induced by such factors as systems of square farming on sloping land, burning of pastures and crop residues and excessive grazing. The destruction of protective vegetation (including the dead ground litter therefrom) by such means immediately alters Nature's former complex relationship between soil, plant cover, and rainfall. Increased runoff and wastage of soil and water follow quickly upon the removal of this surface filter bed which formerly ensured the unimpeded entry of clean water into the soil. Following the removal of the surface cover, water, which can no longer infiltrate into the soil as quickly as it falls, is free to run off at high velocity because of the absence of plant material to hinder and obstruct its downward course. If the resultant increased runoff is permitted or assisted to concentrate in unsuitable drainage ways the formation of gullies is a normal sequence.

Plate 80.

An Area Showing Evidence of Serious Sheet Erosion. Gullying Will Follow Rapidly.

The ploughing of grassed depressions as part of the cultivated fields, the formation of cattle tracks along water carrying depressions, the construction of certain types of farm drains and the collection of water in roadside channels are examples of common practices which lead to the formation of gullies.

Insidious sheet erosion, which on cultivated land normally precedes gully erosion (Plate 80), frequently develops to an advanced degree without attracting attention.

Gully erosion, although often directly damaging less land than sheet erosion, is more spectacular and menacing in appearance and therefore generally tends to provoke immediate alarm. Gullies, once started, will continue to develop and form branches until the factors which contributed to their formation are eliminated. If not controlled, gullies can ultimately render useless for further crop production comparatively large areas of land.

They cause considerable inconvenience to landowners through interference with farming operations, and as they develop and multiply they progressively increase the cost of such work. Further inconvenience is caused by the dislocation of access routes.

A network of deep gullies can adversely affect the yield of crops grown on adjacent land by lowering the soil water table. Not infrequently, serious gullies develop down the headlands of cultivated fields due to the effect of ploughing operations. Usually such gullies undermine and destroy fence lines (Plate 81).

Plate 81.

A Fence Line Undermined by Gully Erosion.

The sub-surface soil and subsoil disgorged from gullies frequently contributes towards the choking of life-giving watercourses with useless debris. Such material is sometimes deposited as infertile and sterile overburden on lower valuable crop land or pasture.

The formation of gullies along arterial and lateral drainage lines is particularly serious and adds considerably to the difficulty of designing safe farm drainage schemes. Originally most of these drainage lines existed in the form of stable and well vegetated depressions; the development of gullies in very many instances has unfortunately resulted from the failure of landowners and others to recognise the importance of preserving them in this condition. The present mutilated condition of many such depressions is directly attributable to the fact that they have been ploughed up for crops or have been abused by stock (Plate 82).

Gullying often occurs in cultivated fields with comparatively small catchment areas. Such cases represent the final stage in the usual farm land erosion cycle and differ from gully erosion in main drainage lines. Following the initial cultivation of sloping arable lands, the first stage in the erosion cycle is the development of insidious sheet erosion in which thin sheets of soil are lost but the topography of the land remains comparatively unaltered. In the next stage, runoff tends to concentrate in depressions which may have been created by certain cultivation practices or methods of ploughing, or which may be natural hollows that were existent prior to settlement. With each succeeding rain these depressions become more defined. More and more water tends to concentrate in them and velocity of flow usually increases

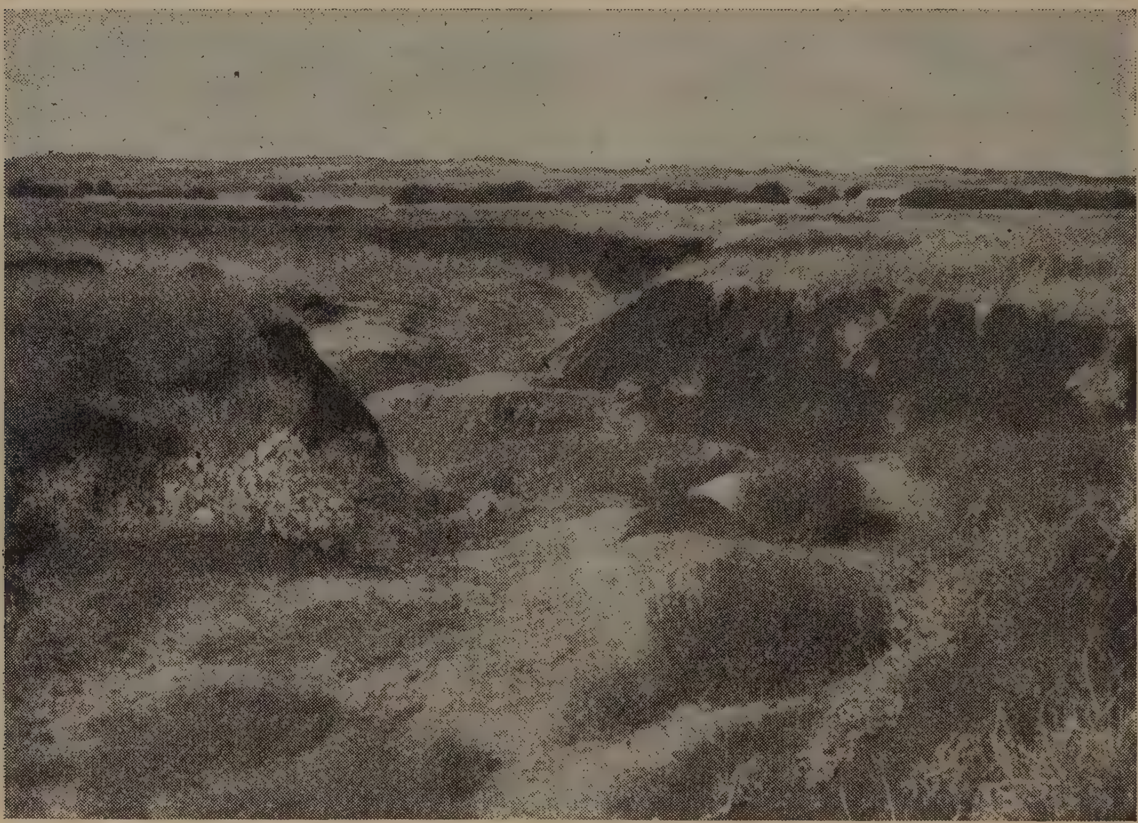


Plate 82.

An Unstable Drainage Line on the Darling Downs.

greatly as a result. Over a period of years these depressions increase in depth through erosive action and so a gully commences; as the depth of the gully increases the sides and head become steep and unstable and thus become increasingly unfavourable for the growth of vegetation.

During the early stages of gully formation, water tends to wash out numerous potholes in the bottom. These then deflect water laterally and ultimately result in the meandering or snake-like course of gullies. Usually from one of the original potholes an active gully head develops which provides inflowing water with a vertical drop (Plate 83).

The energy of the falling water is usually sufficient to undermine the base of the overfall; the overhanging ledge soon breaks off and falls and the process then repeats itself. In this way gullies always eat their way uphill along the centre of the drainage line feeding them. Secondary

Plate 83.

Water Dropping Over the Head of This Active Gully Causes it to Cut Back Along the Drainage Line.

depressions are eventually intercepted by main gullies and from these lateral or branch gullies develop.

For this reason no contour bank or farm drain of any type should ever be discharged into a gully (Plate 84).

Plate 84.

Gullying Occurring Along a Contour Bank Where it Has Been Turned into a Deep Gully.

TYPES OF GULLIES.

Gullies may be broadly classified into two main groups:—

(1) *Those occurring mainly on cultivation land and where the drainage area rarely exceeds* 50 *acres* (Plate 85). These gullies are rarely more than 3 feet deep but may occur at intervals of 200 feet or less across the slope. They represent a very substantial soil loss and in addition cause considerable inconvenience in cultural operations; because of this many of these gullies are ploughed in so that they can be crossed with implements. This practice should not be adopted without the associated construction of contour banks because of the danger of further soil loss in subsequent rains.

Plate 85.

Gully Erosion Occurring in a Cultivation Field With a Comparatively Small Catchment.

(2) *Drainage Line Gullies*: This type of gully occurs mainly in natural depressions which have become unstable due to the loss of protective plant cover. Once gullying commences it rapidly expands in depth and length. Because of the large quantities of soil carried away it is inevitable that deposition of silt will occur as the gradient decreases; ultimately this results in an alternation of overfalls and silt fans throughout the length of the drainage line. Each overfall continues to progress up to the next silt fan which ultimately again becomes an overfall and so the erosion cycle continues. The resultant effect is an accelerated loss of soil in the upper sections of the waterway, sedimentation in lower streams and flooding of level lands where the channel capacity is reduced because of the development of silt fans.

The shape and size of gullies is governed largely by the characteristics of the subsoil. With unabsorptive types of clay subsoil, shallow and wide gullies usually form, while with deep and friable subsoils vertical walled U-shaped gullies develop. The slope and the

size of catchment area draining into the gully are other influencing factors. As moving water tends to reduce the floor of gullies to a level longitudinal gradient, it is a general rule that depth of cut progressively increases as the gully eats upwards.

PREVENTION OF GULLY FORMATION.

Since gullying results from the combined effect of excessive catchment runoff and instability of drainage lines, it can be prevented if these contributing factors are reduced or eliminated.

Runoff may be reduced by the application of the various measures described in previous articles of this series; the most important is the adoption of land utilisation practices which will ensure the absorption and pondage of the maximum amount of rain on the site where it falls.

Protection of drainage lines can be assured if care is taken in the initial ploughing of land to ensure that the existent plant cover in depressions is not disturbed. The fencing of drainage lines to prevent access of stock is the most practical method of ensuring the preservation of cover on these waterways.

Where incipient gullying has commenced in arable lands, stability can be achieved by the construction of a series of contour banks which intercept the runoff water and transfer it across the field at low velocities to a stable well-vegetated outlet or waterway. Under these conditions gullies may be filled in with the assurance that the factors causing the original gullies have been eliminated.

It is better to prevent the development of gullies, firstly because the necessary preventive work can be done at a fraction of the alternative and subsequent cost of reclaiming them, and secondly because it ensures retention of soil which would otherwise be lost.

RECLAMATION OF GULLIES.

The cost of reclaiming gullies is often high, but in estimating the value of such work it is important to realise that a gully directly affecting only a few acres of land may ultimately endanger or destroy large areas of land both above and below its original site. It and other similar gullies may also constitute a serious menace to roads, reservoirs, streams and ports because of resultant siltation.

Gully stabilisation can be achieved most successfully and economically by the utilisation of vegetation to the maximum extent. Probably the most effective, but perhaps not the most practical method, is to reshape the gully if necessary and plant the entire gully with suitable vegetation. This may necessitate the temporary diversion of water during the period of treatment. In many cases stabilisation can be obtained in time by simply fencing gullies out and preventing the access of stock; the planting of vigorous species of plants will assist considerably.

The infertile subsoil exposed in gullies usually makes the establishment of vegetation difficult, but provided stock are excluded and fertilizer is applied a satisfactory growth of vegetation can usually be obtained. Because of the danger of large flows removing the vegetation before it is well rooted, it is preferable to temporarily prevent runoff from entering the gully by the construction of diversion or pondage

banks above the gully head. However, where large catchments are involved, it is impracticable to divert the large volumes of runoff and stabilisation must be effected while the gully continues to serve as a water disposal line.

This can only be achieved by the systematic application of measures designed, firstly, for the elimination of the erosive waterfall effect at the gully head, and secondly, for the reduction of the longitudinal gradient of the gully floor in order to lessen the velocity of flow and induce siltation.

Provided the rate of encroachment of the gully is not rapid, control can occasionally be effected by the use of vegetation only, and without the necessity for earthmoving work or the use of special drop structures such as check dams or flumes. The procedure in this case involves the use of strong vegetative barriers at intervals across the bed of the gully to induce siltation and reduce the water velocity. Such plants as elephant grass and cow-cane are suitable for this purpose; canes up to 3 feet long are planted in a semi-vertical position across the gully bed and partly up the sides. Three rows of canes are planted, 18 inches apart, with 18 inches between canes in the row; each series of canes should be about 50 feet apart. Within a few years these grow into a dense barrier of cane which impedes the flow of water, thus reducing the risk of further erosion. Such barriers also result in the deposition of silt and the gradual raising of the bed of the gully. This provides a favourable site for the establishment of other types of vegetation. At the same time as the barriers are established, vigorous vegetation such as Rhodes grass, kikuyu grass and couch grass should be established on the base and sloped sides of the gully and particularly around the head or overfall.

Although slow, this method of stabilisation is inexpensive and is well suited to those gullies which are only moderately active. The whole of the gullied area should be fenced off to exclude stock.

GULLY CONTROL STRUCTURES.

Since the ultimate aim in gully control work is the establishment of a permanent cover of vegetation over the entire gully, many of the control structures need only be of a temporary nature but must be capable of preventing further erosion during the period in which the permanent vegetation is being established.

Gully Head Control.

A primary requirement is the stabilisation of the overfall at the head of the gully and this can be achieved in a number of ways:—

(1) The overfall is sloped so that there is a batter of at least one in three—that is, a fall of 1 foot for every 3 feet length of the slope. A more gradual batter or slope of 1 in 5 is preferred but in large gullies this may involve excessive earthmoving. After the overfall has been sloped, kikuyu or couch grass is sprig planted at reasonably close intervals and watered. The whole surface is then covered with a mulch layer two to three inches deep and pegged down with wire netting. Provided the work is executed carefully, the mulch will protect the soil surface against damage from

water flow while the grass is becoming established. Care must be taken to make certain that all water passes over the protected zone and not around it, or under it, as it would then create a new overfall.

(2) In this method the overfall is sloped as in the previous case and grouted stone or rock crates are used as a protective lining. The section intended to carry water is dished to the extent of one to two feet in order to concentrate the flow and reduce the width of the structure required. On clay soils which crack when dry, rigid stone grouted structures are seldom successful. Concrete or metal flumes are also sometimes used to ship water down to lower levels. In all cases it is essential that they be made of adequate capacity and that no water passes around the top of them.

Plate 86.

A Wood and Masonry Structure Used to Stabilise a Deep Gully.

Where rock crates are utilised, quantities of small stone are bound with wire netting into convenient units and the crates are tied to each other with wire.

(3) Vertical concrete or masonry weirs or check dams are used to stabilise the overfalls without any appreciable alteration in the slope of the face. If these are erected on a solid and well constructed concrete footing they are much more permanent on heavy clay soils than leaning stone grouted structures. It is most essential that adequate provision be made at the base of these structures to protect them against undercutting. It is also essential either that they be provided with wings to funnel all water through them or that their sides be made some feet higher than the crest of the overflow section to ensure that no water passes around them (Plate 86).

Gully Bed Stabilisation.

This is a very necessary requirement, otherwise further erosion along the bed of the gully will ultimately result in the undermining of gully head control structures.

A series of temporary check weirs erected across the bed of the gully are of value in this connection and assist, firstly, by trapping water and silt to aid the establishment of vegetation, and secondly, by reducing the channel gradient of the gully to a series of level steps and weirs. In this manner the velocity of water flow can be controlled and further erosion prevented until such time as permanent protection has been gained with vegetation.

In the design and construction of these weirs the most important factors are the spacing, height and cross-section; it is highly desirable that the weirs be spaced so that the crest of one weir is level with the base of the weir above, but in special circumstances a gradient not exceeding 1 per cent. is permissible. Spacing and weir height are therefore correlated, but where possible the height of the notch should not exceed 3 feet above the gully bed and it is preferable to reduce this to 2 feet. There is a much greater danger of failure in high structures than in low closely spaced ones during heavy flows; and this factor must be considered in conjunction with the estimation of flow when the control plan is being designed.

The cross-section of the weir should be such that it is lowest at the centre, and the depth and width of the notch or overflow section is determined by the anticipated volume of the flow in the gully. The notch should have sufficient capacity to ensure that the water does not flow around the end of the weir and undermine the structure. It is the neglect to provide a notch which is responsible for the failure of many of the gully control structures erected by landowners in the past. It has often been the practice to lay logs across the gully and the top log presents a level surface from one side of the gully to the other. As soon as water starts to overtop the log it immediately commences to cut into the bank at the ends of the log and results in the undermining of the structure.

The provision of an erosion resistant apron at the base of the weir is essential to prevent undercutting at this point. The most successful type of apron consists of a sub-surface concrete basin which when filled with runoff water serves to dissipate the energy of further falling water.

The type of structure to be used will depend upon the catchment area drained by the gully, the soil type and the size and depth of the gully. Included in the structures which may be utilised are earth weirs, stake and netting structures, brush weirs, and concrete or masonry structures. The cost of these varies widely.

Earth Weirs.

This type of structure is formed entirely of soil which is obtained by dozing in the sides of the gully to at least a 1 in 3 batter at the point where the weir is to be located. The sloped gully sides and the

crest of the weir merge into a smooth concave outline with the lowest part of the weir at the centre. The weir should be at least six feet wide at the top and approximately two feet high; the shoulders of the weir taper gradually to the gully bed with a slope of 1 in 4 or more on the lower side. However, unless these weirs are protected they will wash out during the first heavy rains and consequently it is necessary to plant kikuyu, couch or buffalo grass sods over the entire surface of the weir, then cover with straw to a depth of two to three inches, and finally peg down with wire netting.

This method of gully bed stabilisation, though not widely used as yet, offers considerable promise because of the low capital expenditure involved. The sloping of the gully sides is at all times a necessary prerequisite for the establishment of vegetation and the soil thus obtained can be easily formed into weirs in the bed of the gully. These operations can be performed very effectively with simple dozer attachments on ordinary farm tractors. The key to this method of control, however, is the necessity for the *immediate* sodding, mulching, and netting of the weirs.

Stake and Netting Structures.

These consist simply of a series of netting fences erected across the gully with appropriate precautions to prevent cutting out at the ends and bottom and to induce siltation in the bed of the gully.

The posts are spaced about 8 feet apart and placed at least 3 feet in the ground; it is necessary to carry out some excavation work to ensure that the structure is anchored well into the sides of the gully. These structures are planned so that the centre post is downstream from the side posts, thus creating the desired "notch" effect. The netting is pegged into a trench at least 6 inches lower than the bottom of the gully and finally a semi-permeable layer of brush and straw is established above the netting to induce siltation.

Brush Weirs.

The method of establishment for this type of structure is much the same as for the netting type structure. Posts are erected across the gully, a layer of straw is packed in a trench along the post line, and layers of brush built up below the post line and anchored with a series of wires stretched tightly across the gully and attached to the post. An earth weir may then be established across the gully above the line of posts and the brush serves as an overflow apron for the weir. A double row of posts is sometimes used, in which case the brush is packed between them.

Concrete or Masonry Structures.

The essential difference between these structures (Plate 87) and those previously described is that they are quite permanent; in soils which do not crack these structures will ensure stability without the necessity for the establishment of vegetation. However, they are more expensive to construct and in general are not suited for Queensland conditions where the worst gullying occurs on the black clay soils; concrete or masonry structures are rarely suitable on these soils because of the danger of undermining when runoff water enters cracks above the structure. Tunnels rapidly develop and collapse of the structures soon follows.

These structures are not recommended except in cases where vegetative control can be ultimately depended upon.

Conversion of Gullies to Farm Ponds.

In addition to the methods of dealing with gullies just described, the possibility of converting them to farm ponds should not be overlooked. With large gullies, ponds of moderate to large capacity can

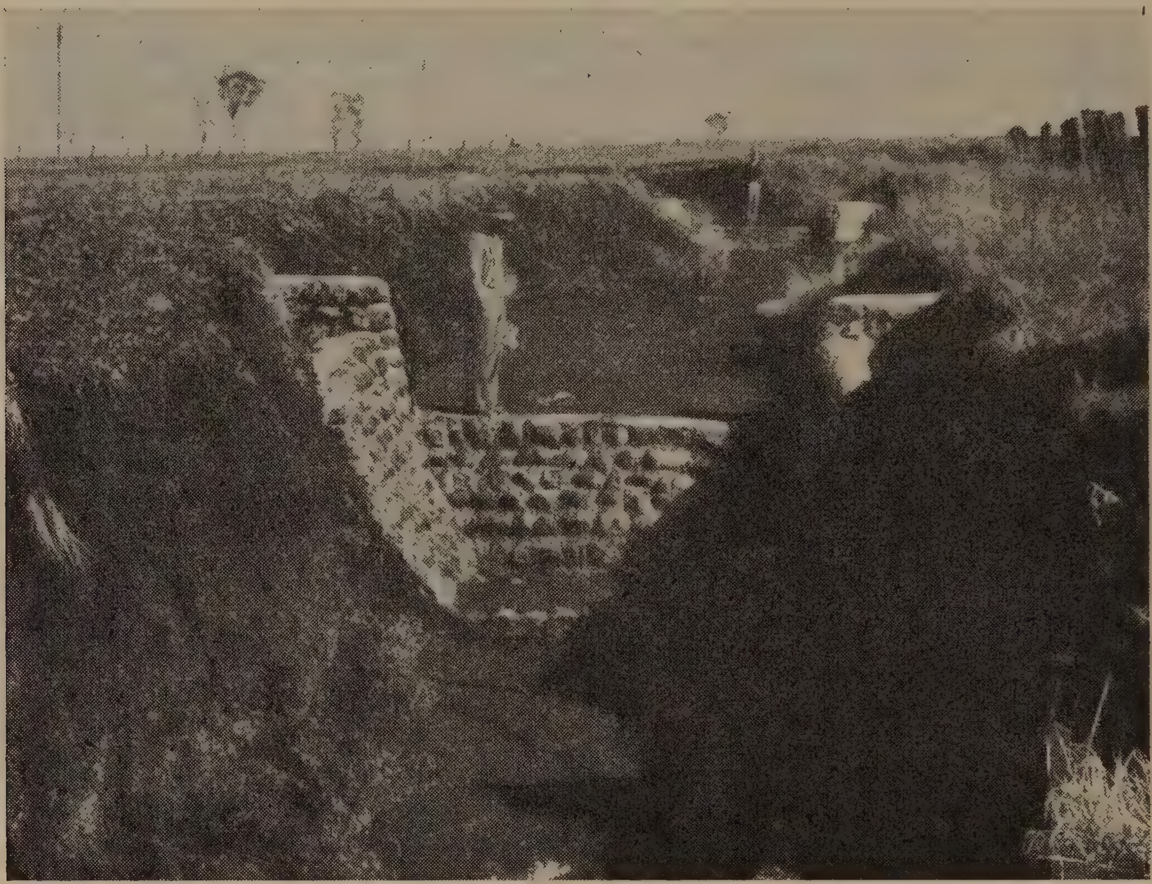


Plate 87.

A Series of Masonry Structures Used to Stabilise the Bed of a Long Deep Gully.—Three feet of soil were deposited above the nearest structure in one rain.

be constructed at comparatively low costs (Plate 88). Special precautions which require to be taken with respect to the construction of these ponds include—

(*a*) The removal of any porous material from the bed of the gully at the point where the wall of the dam is to be built;

(*b*) The protection of the overfall or inlet into the pond to ensure that gully erosion does not occur at this point; and

(*c*) The provision of a stable spillway to prevent water passing around the side of the dam and re-entering the old gully at some unprotected point. Should this happen, the dam would be ultimately undermined. A suitable type of spillway consists of a long contour or diversion bank of adequate size to convey the water around the slope to a suitably prepared waterway or other safe point for disposal. In this way all overflow from the dam can be prevented from returning to the old gully.

Should it be necessary to re-admit water to the old gully below the dam, a specially prepared inlet should be provided. Care must be taken to select the most suitable site, as this side of the gully must be sloped to a gradient not exceeding 1 in 5, and should be sodded with grass and protected with straw and netting in the manner previously described. Attention must also be paid to the stabilization of the bed of the gully and for this purpose check dams or weirs of the type described herein may be required.

Plate 88.

A Farm Pond Constructed to Stabilise a Gully and at the Same Time Provide a Useful Reserve of Water.—Surplus runoff is carried across the field in a diversion bank to a vegetated waterway.

Concrete or masonry drop structures, including flumes, provide an alternative method of admitting overflow from the dam to the gully but are more expensive.

Agriculture in the Callide and Dawson Valleys

O. L. HASSELL, Senior Adviser in Agriculture.

FOR the purpose of this article, the Callide Valley is accepted as that area of land in the Valley from the head of Callide Creek watershed to the township of Goovigen (Plate 89). In the case of the Dawson Valley, discussion herein refers to that portion of the Dawson River watershed from Theodore to Wowan.

From the early days of occupation of the Callide Valley until the early 1920's, the land was used for pastoral purposes. Resumed land and Crown land totalling over a million acres was thrown open from 1924 onwards for selection in small holdings under leasehold conditions. A few selections in the area were subsequently converted to freehold agricultural farms. The size of the selections when the land was thrown open in 1924 was mainly between 160 and 320 acres, but following an economic investigation of the lands in 1929, additional areas were granted to settlers to ensure a sound living based on dairying.

In October, 1923, the Queensland Government opened an Agricultural Demonstration Farm near what is now the township of Biloela in the Callide Valley as a step towards opening the land for closer settlement. The objectives of this Farm were to obtain information for prospective settlers on the best methods of clearing land and fencing and correct methods of land management, and investigation of the culture of crops which were likely to be best suited to the district. In 1924 this Farm became the Department's Cotton Research Station and in 1945 was converted to a Regional Experiment Station with considerably wider functions. The research and investigations on this property have had a considerable influence on the development and progress of agriculture in the Callide Valley. Indeed, many of its findings have been applicable to large areas of Queensland within the 30-inch rainfall belt.

In the Dawson Valley, land at Wowan, Deeford and Dululu was opened in 1912 as freehold agricultural farms and from 1916 onwards further areas were opened under perpetual lease. As in the Callide Valley, some tenants in this area also took the opportunity in 1929 to convert leaseholds to freehold agricultural farms. Although land in the Rannes-Baralaba district was on offer for years under perpetual

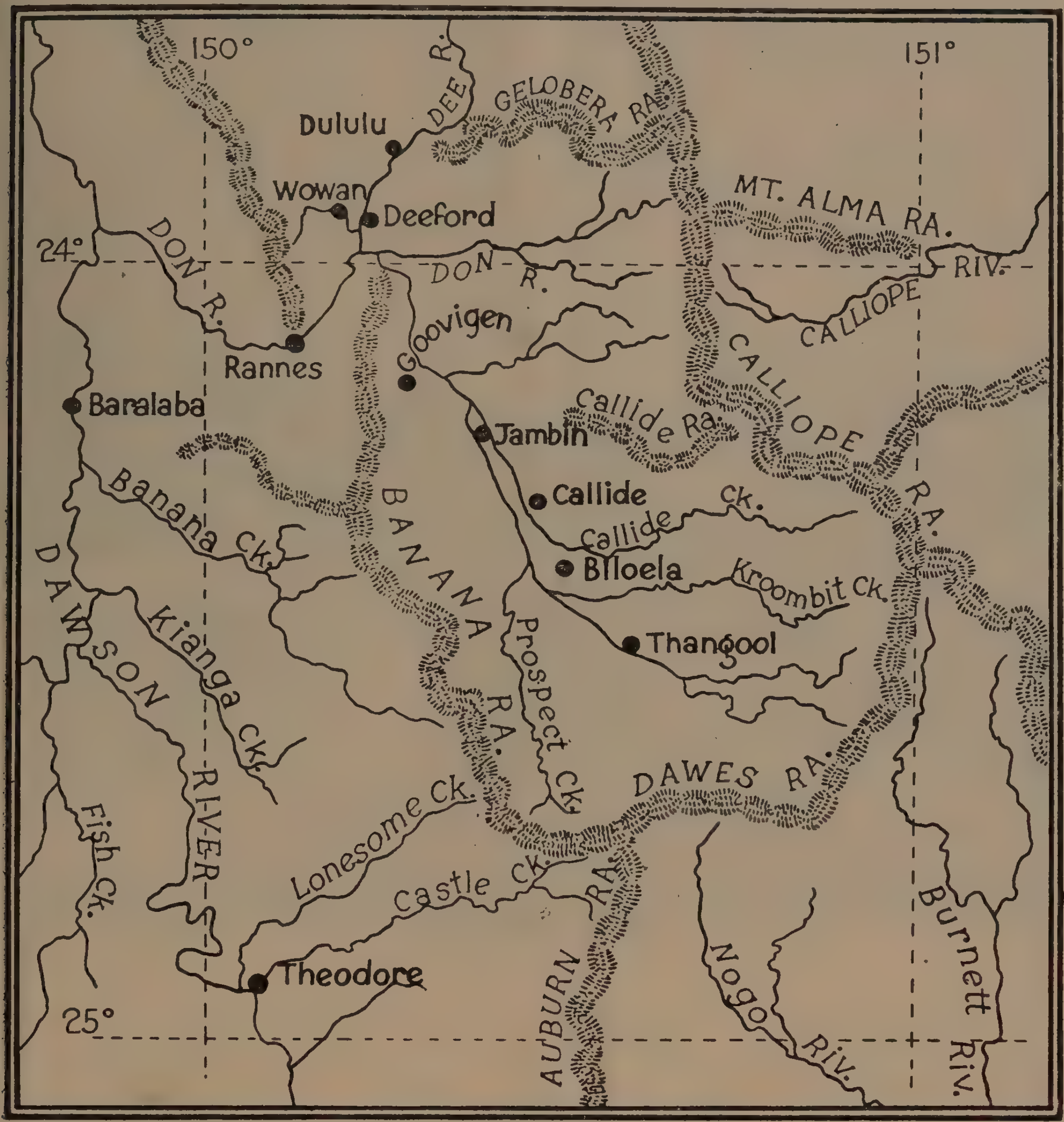


Plate 89.

Sketch Map of the Callide and Dawson Valleys.

lease tenure, the blocks were not selected until reclaimed from prickly pear by Cactoblastis. This land was again opened for selection during 1935-36 under perpetual lease prickly pear tenure. Additional areas were granted to Dawson Valley settlers in 1935.

The Theodore Irrigation Settlement was opened in 1927 on what was originally a grazing selection owned by Mr. W. G. Woolrych. The area was cut into 264 blocks of an average area of 13 acres for irrigation, and 109 dry blocks of an average area of 211 acres.

In the Wowan district the land acquired was mainly portions of grazing selections forming Calliungal expired leaseholds, while at Baralaba the area thrown open consisted of lands unoccupied previously because of prickly pear infestation and resumed areas or expired holdings of parts of a number of properties. The Baralaba-Kokotungo area was cut into blocks of 1,000 to 2,000 acres, the size depending on the quality of the land and the estimated cost of development.

Both the Callide and Dawson Valley settlements are reasonably well provided with rail transport and all-weather main roads. In the Dawson Valley the railway terminates at Theodore, and in the Callide

Valley at Lawgi. State highways lead from both Valleys to the city of Rockhampton, as well as from the township of Biloela to the port of Gladstone and from Biloela to Monto, the main town in the Upper Burnett.

The main townships in the Callide Valley are Biloela (population 940; 102 miles by rail from Rockhampton), Thangool (163; 109 miles), Goovigen (103; 78 miles), and Jambin (66; 85 miles). The more

Plate 90.

A View of Theodore Township, Centre of the Dawson Irrigation Area.

important business centres in the Dawson Valley are Wowan (population 332; 52 miles from Rockhampton), Theodore (386; 148 miles), and Baralaba (465; 89 miles from Rockhampton). Population figures represent the position at the census of June, 1947.

CLIMATE.

The following table gives average meteorological data for the townships of Biloela, Theodore and Wowan:—

BILOELA (RECORDS FOR 19 YEARS).

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
a	92·1	87·5	88·9	84·1	77·1	70·6	71·5	75·8	81·9	84·9	99·3	91·0	83·0
b	68·0	66·3	62·3	56·4	47·9	45·2	40·7	40·4	48·3	54·7	61·5	65·4	54·7
c	456	475	275	198	169	192	132	57	83	174	277	360	2,848

THEODORE (RECORDS FOR 15 YEARS).

c	346	440	272	225	177	165	159	68	65	148	325	409	2,799

WOWAN (RECORDS FOR 21 YEARS).

c	432	524	258	223	128	267	158	72	80	171	288	410	3.011

a = mean maximum temperatures,
b = mean minimum temperatures,
c = average rainfall in points.

Average temperatures for Theodore and Wowan are not available, but would not vary greatly from those shown for Biloela.

Of the rainfall, approximately two-thirds of the total falls between the months of November and April inclusive. Unfortunately, the rainfall is erratic and the real position is not as satisfactory as the picture presented by the averages suggests. During the summer months, periods of up to six weeks may elapse when little or no rain is registered. These rainless periods during a time of the year when temperatures are high cause wilting of crops.

The winter rainfall is light and unreliable, and this makes summer fallowing an essential part of the agricultural programme in the area if winter crops are to be grown.

The summer weather is at times rather trying, as screen temperatures may exceed 100 deg. for several days in succession. The winter is mild and very pleasant. During the winter months frosts occur, usually from the middle of July to the end of August. Occasional frosts have been known to occur as early as April and as late as October. Westerly winds are experienced also during these months, but are not generally considered to play a great part in the severity of the winter.

The prevailing wind is from the south-east.

SOILS AND VEGETATION.

There is a fairly close correlation between soil type and vegetation in the district. The soil types may be divided into (*a*) alluvials, (*b*) brigalow soils, (*c*) softwood scrub soils, (*d*) dark grey-brown clay loams of the plains, and (*e*) shallow gravelly clay loams.

(*a*) *Alluvials.* These are extensive and important soil types which have their maximum development along the main streams. Sandy loams occur near the banks, but the more important types away from the banks are deep, dark-grey clay loams and clays with a good physical condition consequent on a good structural development. These soils have a high fertility and have proved to be very productive. Nevertheless, crop rotation, including several years of pasture, is needed to maintain their favourable physical condition, which is an important factor contributing to their high productivity. The principal crops grown on these soils are grain sorghum, wheat for grain, cotton, and winter and summer fodder crops.

The vegetation is grassed open forest (Plate 91) and the trees consist principally of blue gum (*Eucalyptus tereticornis*), coolibah (*E. coolabah*) and Moreton Bay ash (*E. tesselaris*). Some of the areas are liable to occasional flooding.

These alluvials merge into extensive areas of flat country, in which the dominant tree species is poplar box (*E. populifolia*). This country is an extension of the alluvials, but the soil types are characterised by comparatively shallow profiles, a poor physical condition and only moderate fertility. The soils are grey and dark-grey clays, and in their natural state are tight and compact. Because of their heavy texture and poor structural development, they are not readily permeable to water, so water tends either to run off or to pond on these areas in depressions. They will grow good crops of grain sorghum, wheat and the usual winter and summer fodder crops if the ground is properly worked.

(*b*) *Brigalow soils.* The country rises gradually from the alluvial flats into broad areas of grey-brown clay loam soils carrying principally brigalow trees (*Acacia harpophylla*), with wilga (*Geijera parviflora*) in the undergrowth. The surface horizon of these soils is friable and has a fairly well developed structure. Although the physical condition of the surface soils in their natural state is good, they are liable to deteriorate under intensive cultivation. Crop rotation including several years of grassland must, therefore, be adopted to maintain a good physical state. Although the subsoils are mostly clays, the soils drain fairly freely and waterlogging seldom occurs. Their productivity is good and in normal seasons very satisfactory crops of cotton, sorghum, millets, and other summer crops can be produced.

Plate 91.

A Typical Blue Gum Alluvial Flat in the Callide Valley.

Large areas of this country are laid down to Rhodes grass, which has proved very suitable for this soil type.

In some places, belah trees (*Casuarina lepidophloia*) constitute an appreciable percentage of the brigalow scrub. This association usually indicates the best type of brigalow scrub soil.

Another type of brigalow country on areas of low elevation is characterised by dark-grey soils and melon-hole formation. The soils are friable self-mulching clays of fair to good fertility, but inferior to the brigalow soil previously discussed. Provided the drainage is satisfactory, these soils can be cultivated and will grow good agricultural crops, such as sorghums, and pastures. Usually the areas must first be graded to smooth out the uneven surface. These soils usually cover extensive areas at the foot of ridges. The subsoils are generally a heavy sticky clay.

(*c*) *Softwood scrub soils.* On the slopes of the hills, the softwood scrub type of vegetation (Plate 92) is usually found above the brigalow scrub of the lower slopes. Many tree and shrub species comprise these

scrubs; some of the commoner species include Flindersia (*Flindersia collina*), scrub ironbark (*Bridelia exaltata*), whitewood (*Atalaya hemiglauca*) and messmate (a species of *Eucalyptus*).

The soils are friable, red or brown loams and clay loams of volcanic origin, fairly deep and for the most part merging into a clay subsoil. Fertility is good, and when soil moisture is ample crop growth is excellent. Under these conditions, however, cotton plants may develop an excessive amount of undesirable rank growth. The soils do not retain soil moisture like the brigalow soil types and in dry seasons are inferior to the latter for crop growth.

Plate 92.

A Softwood Scrub in the Callide Valley.

(*d*) *Dark grey-brown clay loams of the plains.* These areas consist of open plain country (Plate 93) and in the aggregate cover a large acreage in the valleys. The vegetation is mainly grass with a few scattered clumps of bauhinia (*Bauhinia hookeri*) and poplar box (*Eucalyptus populifolia*). The soils are mainly friable self-mulching types that lend themselves readily to cultivation. They are very fertile and are capable of high production in seasons of satisfactory rainfall. For the most part they have a good physical condition and are not prone to waterlogging except in some places in very wet seasons.

(*e*) *Shallow gravelly clay loams.* These soils are usually very shallow and the vegetation is grassed open forest. The trees are mainly ironbark (*Eucalyptus melanophloia*), yellow jack (*E. ochrophloia*), and bloodwood (*E. corymbosa*). These soils are associated with elevated country in various parts of the district where grazing is followed (Plate 94). The carrying capacity of the pastures on them is good and the nutritive value of the feed is satisfactory. As well as native grasses, a wide variety of native legumes occur on these soils.

Plate 93.
Plain Country in the Dawson Valley.

Except in isolated cases, soil erosion does not constitute a major problem at present in the district. Gully erosion has done considerable damage on some farms and sheet erosion has been noted on the slopes. With the expansion of the wheat growing industry in the valleys under the system of bare summer fallows, erosion may prove to be a much greater hazard in the future, particularly where clay loams on the slopes are cultivated.

Plate 94.
Grassed Open Forest, with Ironbark Trees in Foreground, near Biloela.

WATER FACILITIES.

Irrigation.

The main irrigation area is at Theodore, where there is an area of 3,526 acres reserved for irrigation purposes. Water for this scheme is pumped from the Dawson River adjoining the area. A weir (Plate 95) across the river at the township backs the water up the river for a considerable distance. Flood and furrow irrigation are the only methods practised in this area. Water is carried from the pumping station to the various farms in open ditches (Plate 96).

Plate 95.

The Main Weir on the Dawson River at Theodore.

The construction and upkeep of the main channels is the responsibility of the Irrigation Commission and the supply of water to each farm is controlled. Farmers notify the Irrigation Commission of their intention to irrigate and the supply of water to each block is regulated accordingly.

The crops grown under irrigation on this settlement are lucerne, cotton, broom millet, wheat for grain, grain sorghum, winter and summer fodder crops, truck crops and citrus.

In other parts of the Valleys there are isolated irrigation plants, where water is pumped from wells, rivers and creeks. In these areas the crops grown are mainly lucerne, cotton, fodder crops and truck crops. There is scope for expansion of irrigated crops in these areas.

A weir has been erected on the Dawson River at Moura, and nearby the Queensland-British Food Corporation has established a large pig farm.

Water for Stock.

On individual properties in the district water is obtained from creeks, rivers, bores, wells and earth tanks. On properties where water is not obtainable from streams or underground sources, earth tanks can be constructed at a reasonable cost. In most cases these tanks have

Plate 96.

The Main Supply Canal, Theodore Irrigation Area.

been found very satisfactory, and if constructed to dimensions adequate for the size of the herd, they will hold enough water to last through most dry periods. These tanks are mainly constructed by contractors with heavy earthmoving equipment.

Difficulty in obtaining an adequate water supply is commonly experienced in the brigalow country, and earth tanks or dams have particular application in these areas.

[TO BE CONTINUED.]

MACADAMIA IMPROVEMENT.

Progress in the Departmental plan to expand the Macadamia or Queensland nut industry on a firm basis has been announced by the Minister for Agriculture and Stock (Hon. H. H. Collins) to-day.

Mr. Collins said that in a recent survey of Macadamia nut plantations some excellent types of trees had been found. Some produce thin shelled nuts suitable for dessert, while others bear thicker shelled nuts with a large kernel and well suited to processing.

Seed from a number of the more distinctive tree types has been planted at the Redlands Experiment Station at Ormiston and next autumn the seedlings will be grafted with scion wood cut from selected trees. These grafted trees will then be used for an orchard planting at the Maroochy Experiment Station at Nambour. Later, nurserymen will be able to obtain good scion wood from the orchard to build up supplies of first class propagating material.

Banana Growing in Queensland.

J. McGREGOR WILLS, Senior Adviser in Horticulture.

BANANAS have been grown for many years along the coastal strip of Queensland from the New South Wales–Queensland border to Cairns, a distance of some 1,200 miles. Climatic conditions vary considerably within this area and cultural practices differ a great deal from district to district. However, most of the crop is produced south of Gympie at the present time, mainly because of the area's close proximity to the more important metropolitan markets.

During the first quarter of the present century, ample virgin land was available for bananas, but much of this has now been cropped. The scarcity of new virgin land in existing producing areas is such that sound cultural practices and efficient soil conservation methods are essential if the annual cut is to be maintained at its present level.

HISTORICAL.

The banana has been an important food plant throughout the world for a very long time; the fruit is sculptured on the ancient monuments of Egypt and Assyria, while Alexander the Great found the plant growing in India during his campaign in the fourth century B.C. The crop has been traditionally linked with the Garden of Eden as the tree of knowledge of good and evil, hence the names given by the early botanist Linnaeus to two well known species—*Musa paradisiaca*, the plantain, and *Musa sapientum*, which includes most of the tall, cultivated banana varieties of today.

The most widely grown variety in Queensland is the Cavendish (*Musa cavendishii* Lambert), which is native to Southern China. In 1826, plants were taken from this area to Mauritius and three years later two were transferred from Mauritius to England. The Duke of Devonshire obtained one of these and planted it in his glasshouse at Chatsworth, where the plant created considerable interest. The specific name *cavendishii* is derived from the Duke of Devonshire's family name. In 1838, offshoots from plants at Chatsworth were taken by a missionary, John Williams, from England to the South Sea Islands, where the fruit soon became very popular. The natives of these Polynesian islands later distributed planting material far and wide and it is probable that existing Cavendish banana plantations in most Pacific countries originated from the single plant grown by the Duke of Devonshire in England 100 years ago.

The banana is now an important food crop in most parts of the world between the latitudes of 29 degrees north and 29 degrees south.

STRUCTURE OF THE BANANA PLANT.

The banana belongs to the Musaceae, a family of monocotyledons which is closely related to such ornamental plants as *Ravenala*, the traveller's tree. In Queensland, the genus *Musa* is represented by three indigenous species, chief among which is *Musa banksii*.

The cultivated banana (Plate 97) is a broad-leaved, perennial plant some eight to twenty feet in height. The stem is entirely below ground level and is known technically as a corm. The long, fleshy roots (Plate 98) arising from the corm develop particularly well in deep, friable well-drained soils with a high humus content. Under suitable conditions, the root system extends laterally for several feet from the base of the plant, but most of the roots are shallow, only a few penetrating to a depth of 30 inches and then only if the subsoil is sufficiently open.

Plate 97.

Cavendish Banana Bearing a Plant Crop.—Bunch at right about three weeks old; bunch at left about 10 weeks old.

The leaves develop centrally from the corm (Plate 99), and the overlapping petioles form a cylindrical false stem (pseudostem). Each successive leaf grows upwards within this pseudostem until it emerges from the "throat" of the plant. At this stage, the broad blade of the leaf is tightly wrapped around a strong fibrous midrib. When growth is vigorous, the leaf does not unfurl until it is clear of the "throat," but during cold or excessively dry weather unfurling may begin earlier and induce what is generally known as a compacted pseudostem. As the plant ages, the older leaves die and fall back over the pseudostem.

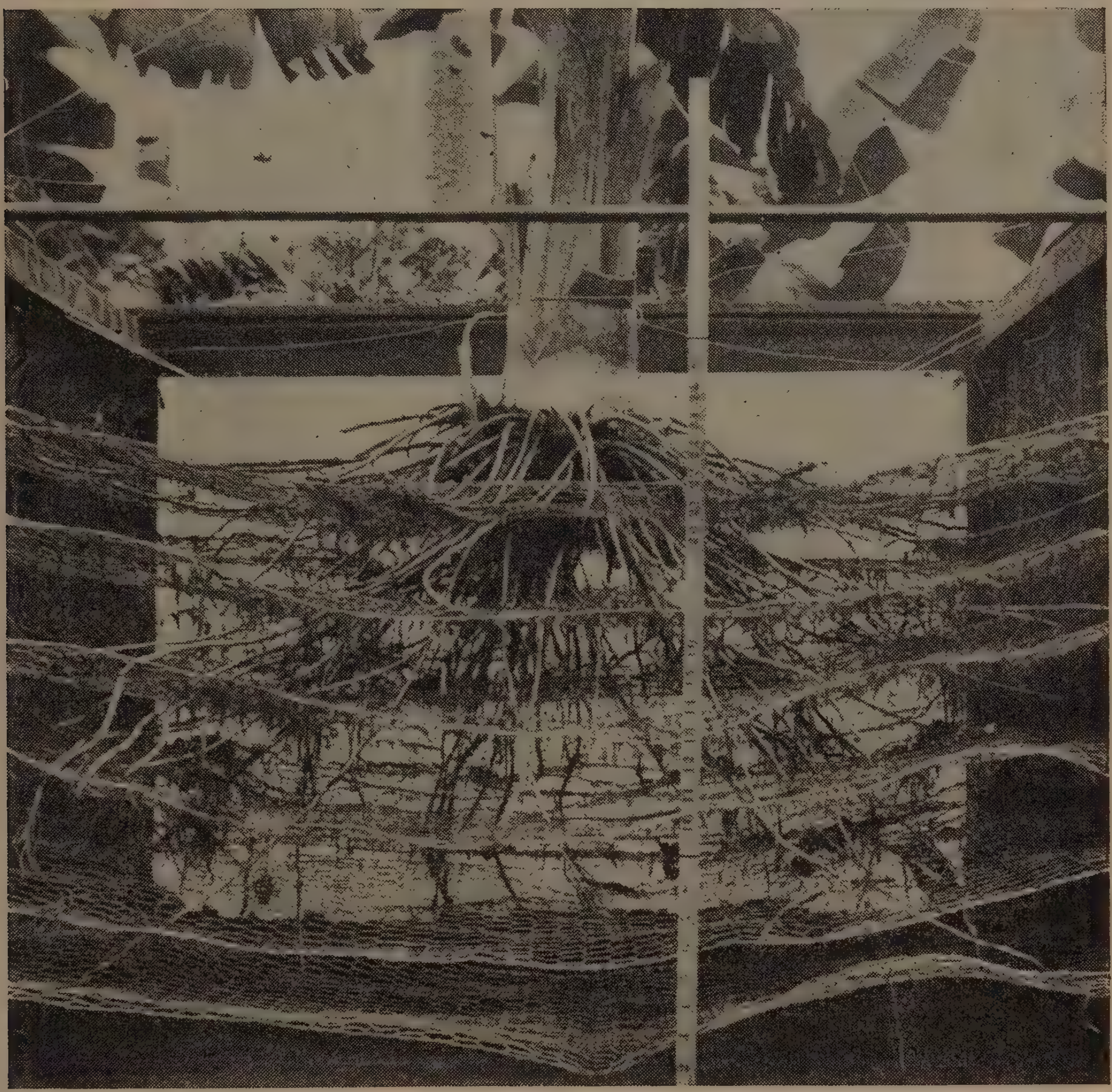


Plate 98.

Root Distribution.—Roots are about one-third of an inch in diameter and the same thickness throughout.

The inflorescence is borne on a stalk which arises from the corm in much the same way as the leaves. The flowers are grouped in hands arranged spirally around two or three feet of the stalk. The flowers are potentially bisexual, but female characters are dominant in the flowers near the base of the stalk and recessive towards the tip. Thus the flowers from base to apex are often referred to as female, hermaphrodite and male respectively, according to their position on the stalk. When the inflorescence emerges from the throat of the plant, the basal fruits are already well developed. Climatic conditions and plant vigour influence the number of hands, the number of flowers which produce fruit on each hand, and also the size of the individual fruits.

The cultivated banana is a self-sterile plant produced by age-long selection in countries where plants of the genus *Musa* were indigenous. Its survival in spite of the lack of seed is due to the practicability of reproducing the plant by vegetative means and its importance as a food crop. Reproduction is normally effected by offshoots from the parent corm, which are generally known as "suckers."

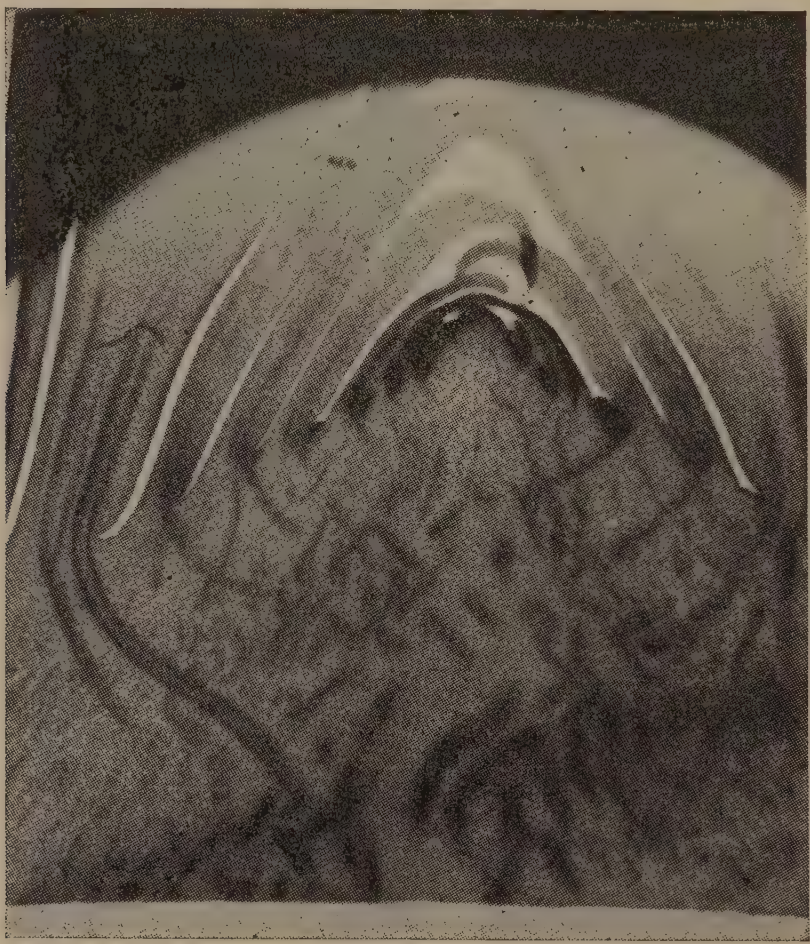


Plate 99.

Longitudinal Section Through Growing Point of the Corm.— The Youngest leaves grow out from centre.

VARIETIES.

The Cavendish variety is a dwarf type which is tolerant of high winds and bears very heavy crops of fruit. It is immune to Panama disease, which commonly affects tall growing varieties such as Lady Finger and Sugar. The semi-dwarf Mons Mare and the very similar Williams' Hybrid are mutations from the dwarf Cavendish, the former being first selected for commercial production at Buderim Mountain in Queensland and the Williams' Hybrid near Coff's Harbour in New South Wales. Mons Mare and Williams' Hybrid attain a height of from ten to sixteen feet when grown on suitable soils. Under comparable conditions, the bunches of Mons Mare and Williams' Hybrid are larger than those of Cavendish, the fruit grades better and the hands are more widely spaced. The Mons Mare and Williams' Hybrid bananas are more tolerant of marginal soil and climatic conditions than Cavendish. They are generally preferred in commercial production south of Brisbane, particularly in higher altitudes where Cavendish may fail to grow satisfactorily.

The tall varieties, Lady Finger (Plate 100) and Sugar, are generally grown on frost-free river flats. However, the severity of Panama disease in this type of country has induced some growers to plant the Lady Finger on higher land which would normally be planted to dwarf and semi-dwarf varieties such as Cavendish and Mons Mare (Plate 101). Provided the tall varieties are effectively protected from high winds by the topography of the plantation, they do well on the higher slopes.

The Embul Hondarawala, imported from Ceylon some years ago, is the tallest variety grown in Queensland, but commercial production is still on a small scale. It attains a height of 16 to 18 feet and can be grown successfully either on alluvial flats or on slopes. Owing to its great height, slender pseudostem and very large bunch, efficient propping is impracticable and heavy losses are inevitable if the plantation lacks good natural protection from strong winds. The fruit is particularly attractive, has an excellent flavour and carries well to distant markets.

The Gros Michel, although the most important banana variety in world trade, is not grown commercially in Queensland, though isolated plants still exist in North Queensland. Its lack of importance is due primarily to a marked susceptibility to Panama disease. Other varieties

Plate 100.

Lady Finger Bananas at Pimpama, South Coast District.

Plate 101.

Banana Plantation at Upper Coomera.—Lady Fingers at left foreground; Mons Mare at near centre.

known in Queensland but of little commercial interest are Red Colombo, Red Dacca, Green Rajah, Ducasses' Hybrid, Blue Java, Lubin, and Plantain.

The main characteristics of the more important commercial varieties of banana in Queensland are given in Table 1.

TABLE 1.

COMMERCIAL VARIETIES OF BANANA IN QUEENSLAND.

Variety.	Pseudostem.	Leaves.	Bunch.
Cavendish ..	6 ft. high; green but heavily pigmented	5 ft. long; up to 24 in. wide	Medium to large; 8-10 hands
Mons Mare, Williams' Hybrid, Viemama	10-15 ft. high; robust; green, but heavily pigmented	7 ft. long; up to 30 in. wide	Long and cylindrical; 10-15 hands
Sugar	12-14 ft. high; light green	6-7 ft. long; about 20 in. wide; green edges tinged with pink	Small; 5-6 hands; fruit short
Lady Finger ..	14-18 ft. high; sturdy; light-green and lightly pigmented	8ft. long, 30 in. wide; light-green; slightly drooping habit	Medium; 5-8 hands; fruit dumpy
Embul Hondarawala	16-18 ft. high; tapering to apex; clear, light-green with light pigment	10-11 ft. long, 30 in. wide; new leaves erect	Large, long and cylindrical; fruit well-spaced; abruptly curved at base; tips pointed

SELECTION OF LAND.

As would be expected from the type of country in which plants of the genus *Musa* naturally occur, the cultivated banana requires a very fertile soil which is well drained and free from waterlogging. In Queensland, the crop is grown mainly in the sub-tropics, where the climate is characterised by a summer rainfall. As the banana cannot tolerate dry conditions for any length of time, and as such conditions frequently occur during spring and early summer, it is imperative that the subsoil be fairly retentive, at least in districts where irrigation is impracticable.

Important factors in the selection of land for banana production are a rainfall of from 50 to 100 inches per annum, high soil fertility, and a subsoil which, while not impeding drainage, holds sufficient moisture to tide the plant over dry periods whenever they occur. These conditions are best satisfied by virgin soils which have not been exploited for horticultural purposes and are therefore rich in plant nutrients, contain large amounts of organic matter, and possess a good structure. For the most part, therefore, bananas are preferably grown as a developmental crop on land which is to be used for other purposes when the cropping period for bananas has ended.

In North Queensland, varieties such as Cavendish and Mons Mare are frequently grown on alluvial soils. In southern Queensland, however, tall varieties such as the Lady Finger are preferred on this type of country.

Good banana plantations occur on soils derived from many different types of rock. For high productivity and long plantation life, however, the basaltic soils are considered most suitable for the crop.

When selecting land, growers use the natural vegetation as a guide to its suitability for bananas. Potential banana soils occur both in rain forest and open forest associations.

The rain forest (Plate 102) or scrub soils are usually deep, friable loams, rich in humus, and well drained. When derived from basalt they may be stony on the surface, but this is not a serious drawback as the stones impede surface runoff during heavy rains and therefore minimise soil erosion even on steep slopes. Dense vine growth and tall, straight softwood timbers such as carrabeen, crow's ash, bolly gum, and cedar are typical of this type of country throughout the State. During the past twenty-five years most of the rain forest in southern Queensland has already been cleared, and in some districts it is now difficult to find areas of virgin scrub land for bananas, except in relatively inaccessible situations at the heads of gullies or high up on mountain slopes. In central and northern Queensland, suitable land of this type is still available in quantity and will doubtless be used in future.

Former scrub soils now under pasture may be utilised for bananas, provided the land is ploughable and can be prepared for planting at a reasonable cost. The steeper slopes in this type of country which were formerly used for bananas and are now covered by lantana and sapling regrowth up to seven years old may also be cleared and planted to the crop. In both cases heavy applications of fertilizer will be needed for maximum production.

Open forest soils carrying hardwood trees are normally less fertile than rain forest soils in areas where bananas are grown commercially. However, if the land is selected carefully and the plantation managed efficiently, payable crops can be produced on them. In the open forest soils, trees such as bloodwood, grey gum and tallow-wood, especially when accompanied by dense undergrowth, are indicators of reasonably deep, well-drained, friable loams containing large amounts of organic matter. Open forest soils supporting mahogany, turpentine or spotted

Plate 102.

Cavendish Banana Plantation, South Coast District, on Virgin Rain Forest.

gum are usually shallow and erode rapidly if precautions are not taken to prevent soil wash. In any case they rarely produce more than one plant and two ratoon crops unless very heavily fertilized.

Alluvial soils vary considerably in coastal districts. Some are relatively fine to coarse silts overlying a porous subsoil; others are medium to heavy loams overlying clay. The fertility of these soils depends very largely on their origin. Except in very wet areas the lighter alluvials are of little value for bananas unless the grower can

install irrigation equipment and is prepared to use it regularly in conjunction with heavy fertilizer applications. The heavier alluvials are capable of producing good crops of bananas provided care is taken to provide the requisite drainage. In some parts of southern Queensland, excellent crops of tall varieties are grown on heavy but relatively shallow soils. The management of plantations on such soils requires considerable skill on the part of the grower.

SELECTION OF SITE.

The banana plant requires ample soil moisture and relatively high temperatures for its development. Both are influenced by the elevation, aspect, and natural shelter of the plantation area. Freedom from frost (Plate 103) is essential, although tall varieties such as Lady Finger and Sugar are rather more tolerant of cold conditions than the

Plate 103.

Lady Finger Bananas at Currumbin, Showing Frost Injury.

dwarf and semi-dwarf types. This tolerance of cold conditions in tall varieties is mainly due to the rapid growth of the plants during the first summer after planting; the susceptible crown and leaves are well above ground level where cold air accumulates during winter. In southern Queensland there is a distinct segregation of varietal plantings in terms of altitude as follows:—

0—1,000 feet	Lady Finger and Sugar
400—1,000 feet	Cavendish
400—1,300 feet	Mons Mare and Viemama
1,000—1,500 feet ..	Williams' Hybrid

Sites affected in winter by down-flowing currents of cold air from hills are unsuitable for bananas, as severe chilling retards plant growth, delays bunching, and causes fruit blemishes. Tops of ridges should not be cleared for bananas if the plants will be exposed to cold winds.

Except in North Queensland, where aspect is less important, plantations should face from east to slightly west of north. Such aspects are naturally warm and moist since they are open to the morning sun and protected from strong southerly and westerly winds by either topography or natural timber.

PREPARATION OF THE LAND.

In virgin rain forest or scrub, undergrowth is usually brushed and the standing trees are felled between April and June so as to allow ample time for the timber to dry out before burning between September and November. In open forest, clearing may be delayed until June or July, since most hardwood trees burn well within a few weeks of felling. In replant land, the lantana is brushed and young saplings are cut down about six weeks before the actual burn, when, if the day is calm and sunny, an effective clean-up can be expected. Old pasture land should be rough-ploughed across the slope during early spring and as much grass as possible worked out of the soil before planting; any blady grass or bracken must be grubbed with a sharp mattock to ensure its destruction.

FELLING AND CLEARING.

In preparing virgin land for bananas, the undergrowth should first be cut close to the ground so that no stakes will escape the burn and remain as dangerous obstructions in the plantation when it is established. As far as possible, trees should be felled across the slope, for scorched logs left in this position after a burn reduce soil drift down the slope. A good burn can only be expected if all upright branches are lopped and stacked around the larger timber before starting the fires. The cost of brushing and felling rain forest varies from £4 to £6 per acre at the present time, but inexperienced growers may engage expert timber fellers to do the work. The cost of brushing and felling open forest is much greater and may reach £40 per acre in heavily timbered country.

CONTOURING.

As bananas are very largely grown on steep slopes in the more important producing areas, steps must be taken to minimise soil erosion by controlling the flow of surface water during periods of heavy rain. Contouring is, therefore, a necessary practice in many districts.

In preparing land for contour planting, it is first necessary to construct a contour drain above the proposed plantation site, to divert surface water from the higher slopes to a suitable outlet such as a grassed gully. Below this master drain, the rows are marked out on near-contour lines with a fall of 2 in 100 and shallow drains are dug between every third and fourth row of bananas. These drains carry surface water slowly from the plantation and usually lead to the same natural runway as the master drain.

In new plantings, the rows are spaced at intervals of 9 to 14 feet, depending on the requirements of the variety to be grown. With the closer spacings (9 to 11 feet), the drains should be constructed between the fourth and fifth rows, the eighth and ninth rows, and so on down

the slope; with wider spacings, the drains should be made between the third and fourth rows, the sixth and seventh rows, and so on. The depth of the drain is from 15 to 18 inches, depending on the rainfall of the district.

An alternative method of marking out the area is to form the contour drains first and then set out the plant rows between each pair of drains in the most practicable way. If the drains are far from parallel, it will be necessary to provide one or more short-spur rows to maintain the required plant and row spacings.

In banana areas already established and not planted on the contour it is still practicable to install cross drains to divert surface water and reduce soil erosion. These drains need not necessarily follow the plant rows and may deviate from the normal fall of 2 in 100, in order to avoid existing stools. The construction of such cross drains involves little labour and does much to ensure a relatively long producing life for the plantation.

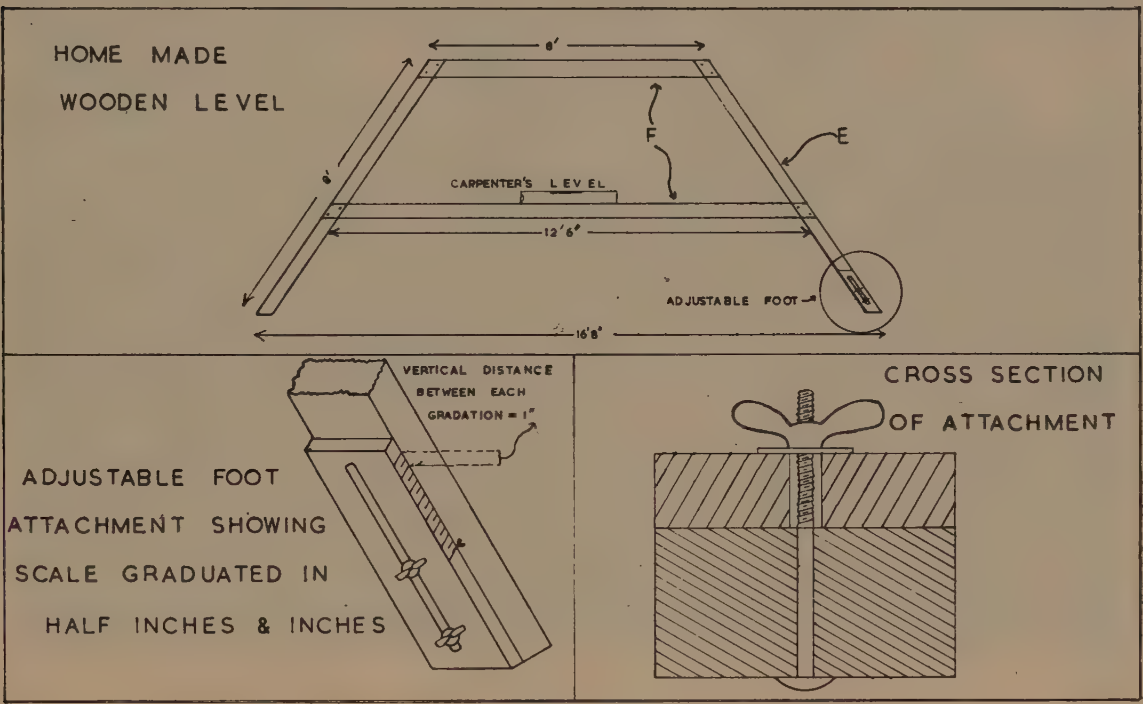


Plate 104.

"A" Frame—Plan and Specifications.—The "A" frame is useful in hilly country for running contour lines when preparing land for planting.

USE OF THE "A" FRAME.

For contour work one of the simplest and most inexpensive types of equipment is an "A" frame (Plate 104), which may be made of pine or any other light timber and provided with a spirit level at least 12 inches long. The legs "E" are made of 3 x 2 timber, with two horizontal bars "F" of 3 x 1 mortised into the legs. A frame with an 8 ft. top bar 49 inches from the ground and a 12 ft. 6 in. bottom bar is convenient for a man of medium height to handle, but the heights may be varied to suit the individual. For convenience in calculation, the bases of the legs should be 16 ft. 8 in. (200 inches) centre to centre. A short movable extension is bolted to one of the legs so that it can be adjusted to give the desired fall; a 4-inch extension on the frame will give a fall of 2 in 100.

To mark out the contour line, a peg is set in the ground at the highest point of the land to be contoured. The extension of the leg of the "A" frame having been set for the required fall, the shorter leg is placed on the ground at the base of the peg and the frame moved around, using the attached spirit level to keep it horizontal, until the longer leg just touches the ground. A peg is then driven in at this spot and the operation repeated using this peg as the base for the short leg and a third peg driven in where the longer leg touches the ground. This procedure is followed until the first line has been pegged. Next select what appears to be the least slope down the hillside and measure

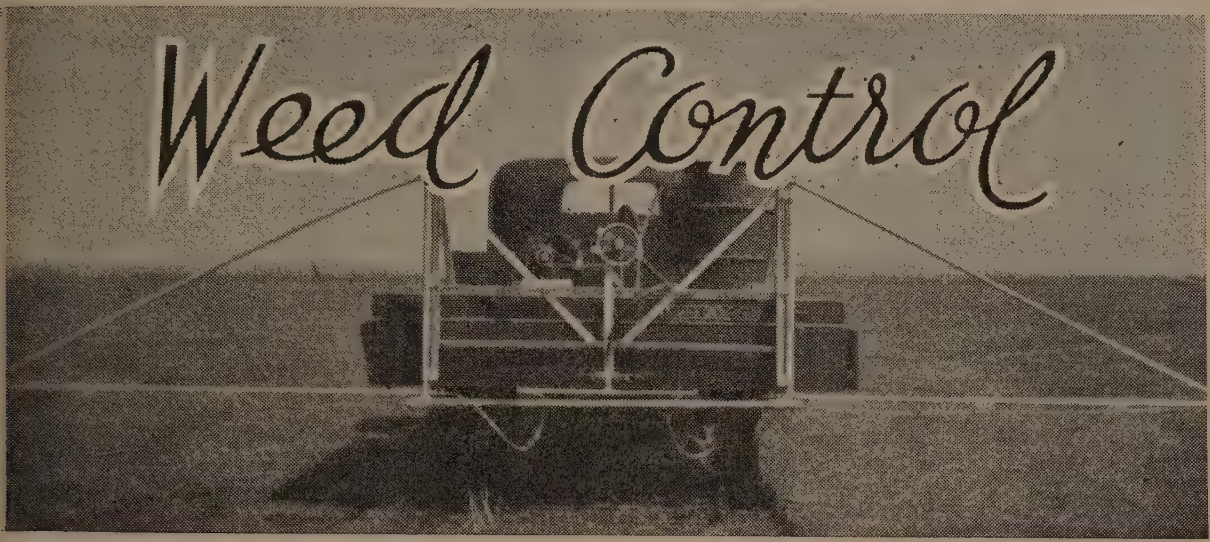
Plate 105.

Contour Planted Bananas, North Coast District.—Note interrow drain and the mulch cover of blady grass.

off a distance equal to the row spacing which has been decided on. Using this as a starting point, mark out the next contour line, and so on down the slope until the whole area has been completed.

The contour lines (Plate 105) so marked out will usually twist about across the slope, and the distance between them will vary according to the unevenness of the land. The length of the rows will therefore differ and the planting positions when marked out will not always correspond from row to row. This is not a disadvantage, as the staggering of the plants will assist in impeding the downward flow of water between drains.

[TO BE CONTINUED.]



Control of Eucalypt Seedlings and Suckers.

B. EASTERBROOK (formerly Assistant to Weeds Officer).

THE method generally used to clear country of eucalypts is ringbarking, followed in due course by removal of the dead trees if the land is needed for cropping. Where the original forest consists of large trees, ringbarking usually results in a good kill of treated trees. Some suckering occurs, chiefly from just below the place where the trunks were "rung," but on the whole regrowth from large trees is not a serious problem. Following ringbarking, the land may be sown down to pasture plants, or native grasses allowed to thicken up to form a pasture. As the pasture is developing, a dense crop of eucalypt seedlings often appears, and in the absence of competition for light, moisture and soil nutrients by adult trees, these develop rapidly and frequently within four years are 10 feet or more high.

Attempts at eradicating young trees in the past have largely followed three methods:—

(1) *Brushing.*—This is ineffective, as the seedlings sucker readily when rung or cut down. The size a eucalypt must reach before it loses its power of prolific suckering when rung or cut down probably varies greatly according to the species and with various other factors.

(2) *Burning.*—This usually gives a negligible kill of the eucalypts and encourages the spread of weeds such as bracken.

(3) *Poisoning with arsenic.*—The plants are frill poisoned or cut down and the butts swabbed with an arsenical solution. Good results are sometimes obtained with this method, particularly if the poisoning is carried out during the period from May to July. However, it is rather variable in its results and has the serious disadvantage of requiring the exclusion of stock from a treated area until some good falls of rain have occurred.

In view of the deficiencies of the methods described, attempts have been made to find other ways of dealing with seedlings and with young trees which have suckered after ineffective brushing or poisoning.

Mechanical Treatment.

The bulldozer appears to be a suitable implement for clearing this type of vegetation. It has been found possible, by striking the stems a few inches above the soil surface, to remove trees and suckers up to about five inches in diameter without any disturbance of the topsoil by the bulldozer blade. All parts from which regrowth may occur are then dragged out. Small stems may bend over, but by running the bulldozer back in the opposite direction these can be dragged out. Odd stems will break off and regrowth may occur on these, but it appears likely that the amount of regrowth which can be expected after bulldozing is very slight.

Various other mechanical means, such as dragging heavy cables between tractors, have also been devised for clearing land of seedlings and suckers, and these appear to be fairly successful.

The area treated is ready immediately for cultivation or for sowing down to pastures and in this respect mechanical methods have a big advantage over chemical methods. However, in some situations it is not possible to use mechanical methods and in these cases a chemical which will kill the regrowth satisfactorily and be harmless to stock is needed.

Chemical Treatment.

Weedkillers of the hormone type, such as M.C.P.A. and various formulations of 2,4-D, have been tried at numerous strengths and rates of application as foliage sprays on seedlings and suckers up to nine feet high, but in no case has a worthwhile degree of control been obtained.

One of the more recent materials, 2,4,5-T, reputed overseas to be particularly effective on trees and shrubs, would have a limited usefulness as a spray for eucalyptus control because of its cost, but experiments on swabbing and frill-poisoning with this weedkiller, both alone and in combination with 2,4-D, are being carried out. Conclusive results have not yet been obtaned but the following notes may be of use to anyone wishing to test hormone weedkillers on a small scale on eucalypts.

No difference has been observed between frill-poisoning and swabbing, and as the latter is generally quicker, it is to be preferred. The stems should be cut off as near to the ground as is possible and the poison applied soon after cutting. The best method of applying it is to use a knapsack spray pump with a single nozzle giving a cone-shaped spray. The ordinary double cyclone nozzles will do if one is blocked. A high pressure should be maintained, and a quick, efficient cut-off valve is essential. The nozzle should be held two to three inches above the stump and a small amount of poison sprayed on to the stump. For stems up to four or five inches in diameter, an average of one fluid ounce of solution per stem is actually a little more than is necessary and no better kill results from applying more. It is necessary to cut off and poison all stems, however small they may be. If any small stems are left intact after the main stems have been severed, regrowth may occur from the base of these.

Salts and esters of 2,4-D have given a poor kill. A high percentage kill with 2,4-D on blue gum has been reported elsewhere, but it does not appear likely that this result will be generally applicable for

swabbing treatments. The sodium and triethanolamine salts of 2,4,5-T in water and the ester in power kerosene have given about a 90 per cent. kill, and the ester in water an 85 per cent. kill. The combination of 2,4-D and 2,4,5-T esters in water has given a very poor kill, but in power kerosene has given about a 90 per cent. kill. Power kerosene alone has given a 40 per cent. kill.

The concentration used in all cases was 1·0 per cent. acid equivalent. This is obtained as follows: If the concentrate purchased contains 40 per cent. active ingredient, one part to 40 parts of water or kerosene gives a 1·0 per cent. solution. If the concentrate has 36 per cent. active ingredient, one part to 36 parts gives a 1·0 per cent. solution and so on.

It is probable that poisoning with 2,4,5-T will be more successful if carried out during the middle to late summer period, although this has not been definitely established.

The main eucalypts tested have been bloodwood (*E. intermedia*) and spotted gum (*E. maculata*) ; small scale tests have been made on blue gum (*E. tereticornis*), ironbark (*E. drepanophylla*), and grey gum. It appears that all these eucalypts are susceptible to 2,4,5-T when it is applied in swabbing treatments.

A few small tests carried out on hickory wattle (*Acacia aulacocarpa*) and forest oak (*Casuarina torulosa*) suggest that these species are also highly susceptible to 2,4,5-T in kerosene. Small tests on brigalow (*Acacia harpophylla*) and mahogany (*Tristania suaveolens*) gave promising results.

It has been found that hickory wattle (*Acacia aulacocarpa*) and green wattle (*Acacia mollissima*) can be killed also by spraying the bark from ground level to about two feet up the stem with 2,4,5-T in kerosene, without cutting the stems in any way. This method leaves the trees still standing but in some situations may be useful. It has been of no use on spotted gum, grey gum, ironbark or bloodwood.

Acknowledgment.

It is desired to express thanks to Mr. E. K. Beattie, of Wolvi, for much help in carrying out the experiments.

Precautions in Using Dinitro Weedkillers.

AMONG the selective weedkillers in use in Queensland is a material which has as its active constituent sodium dinitro-ortho-cresylate. This is used here mainly for the chemical weeding of onion crops, but in England and America is quite extensively employed in cereals as well as onions and various other crops.

Several deaths and numerous cases of non-fatal poisoning by dinitro compounds have occurred overseas, mainly among sprayers working in grain crops in warm weather. The purpose of this note is to draw the attention of farmers to the hazards of using dinitro compounds without adequate precautions.

Some people are more susceptible than others to poisoning by dinitros. The more contact a man has with the material, the greater the risk he runs. The average onion grower, with only a comparatively

small area to treat and using a dinitro spray perhaps for only a short period each year, would not be exposed to nearly the same danger as a team of men engaged on contract spraying. Nevertheless, the danger of poisoning is there and should be guarded against.

How Poisoning May Occur.

Dinitro compounds may cause poisoning by being swallowed, by being breathed in, or by being absorbed through the skin. No great amount is likely to be swallowed, but both inhalation and skin absorption can happen quite easily. Skin absorption probably presents the greatest risk of all, because dinitros do not set up an irritation when they are spilt on the skin and a fatal dose could easily be absorbed through the pores unnoticed. Incidentally, the amount of yellow skin discolouration is no indication of how much the skin has absorbed.

Precautions to be Taken.

Anyone handling dinitro compounds, even occasionally, is advised by the Director-General of Health and Medical Services to observe the following precautionary measures:—

1. Beware of concentrated solutions. If any of the concentrate splashes on to the skin, wash it off immediately with soap and water. If it soaks through the clothes, change them at once. The greatest danger lies in absorbing the concentrate through the skin.

2. Avoid contamination with the spraying solution even though it is dilute enough to be comparatively harmless. Repeated contact may cause poisoning.
   - (*a*) Don't use leaking apparatus or overfill the knapsack spray so that the solution spills on the clothes and skin.
   - (*b*) Whenever possible, spray in calm periods when it is possible to avoid the mist while spraying.
   - (*c*) Do not adjust the nozzles while the spray is running, otherwise quite a deal of spray may be inhaled.

3. Take care with the residue which dries out on the spraying apparatus—it can be dangerous.

Symptoms.

The symptoms of dinitro poisoning are easily recognised. Excessive thirst, excessive sweating, and progressive loss of weight are the danger signs. If any or all of these symptoms are noticed, stop using the spray and see a doctor immediately.

ADDITIONS TO TECHNICAL STAFF.

Seven men who recently graduated in veterinary science at the University of Queensland have joined the Department's Division of Animal Industry. Five of the new appointees held Departmental scholarships.

The Minister for Agriculture and Stock (Hon. H. H. Collins) said that these appointments will enable the ever-increasing demand from the livestock industries for technical services to producers to be more fully met. Those appointed as veterinary officers will work in the field and on research problems, while the others will serve as husbandry officers attached to the Sheep and Wool and Cattle Husbandry Branches of the Division.

How to Produce Choice Cream.

E. B. RICE, Director of Dairying.

DAIRY buildings and equipment of a reasonable standard are conducive to efficiency in the routine of a dairy farm, but much can be achieved even with limited facilities, provided every care is taken which skill and experience suggest. There are, however, two primary requirements for the production of cream of high quality—

(1) An abundance of water at the dairy shed (Plate 106);

(2) Adequate facilities for boiling water; a 12-gallon copper (or its equivalent) provides the minimum requirement.

Plate 106.

Water for the Dairy Shed.—An adequate supply of water at the dairy premises is essential for clean cream production.

On many farms on which low quality cream is frequently produced these essentials are often lacking. They should be given priority over all other considerations by any producer who may only gradually be able to bring his premises into conformity with the Dairy Regulations.

Other important requirements for effective dairy shed hygiene are—

(3) A wash-up trough.

(4) A metal-piping draining rack for storage of utensils and cream cans.

(5) A supply of suitable brushes, detergents (cleansing compounds, such as washing soda or soda ash for utensils to be washed by hand and caustic soda for washing milking machines), and a chlorine compound for rinsing utensils and cans just before re-use.

The rules of dairy hygiene set out below have been prepared with the object of assisting in the production of choice quality cream. By studying the rules and then by strictly amending any practices found to be at fault, any supplier of low-grade cream should be able to bring about a prompt improvement in quality to choice grade.

Rules of Dairy Hygiene.

1. All milking cows should be sound and healthy.

2. Freshly-calved cows' milk should not be separated until at least five days after calving.

3. Before milking begins, rinse with clean water, or a weak chlorine solution, all cream cans and utensils (including the milking machine, if used).

Plate 107.

A Concrete Holding Yard Facing the Bails is an Asset on a Dairy Farm.—Note the large shade trees in the outer yard, which provide ideal summer shade for cattle waiting to be milked.

4. Wash udders and teats with a cloth moistened in a weak chlorine solution. Keep enough cloths to enable each to be replaced as it becomes soiled.

5. Test the foremilk of each teat to observe if the milk is normal. Keep a separate small vessel for the foremilk, which, if sound, may be subsequently fed to pigs, or rejected. A piece of black cloth fixed over the strip-cup helps in detecting clots, presumptive evidence of udder trouble.

6. After milking, wash, scald, and hang udder cloths to dry in a dust-free place.

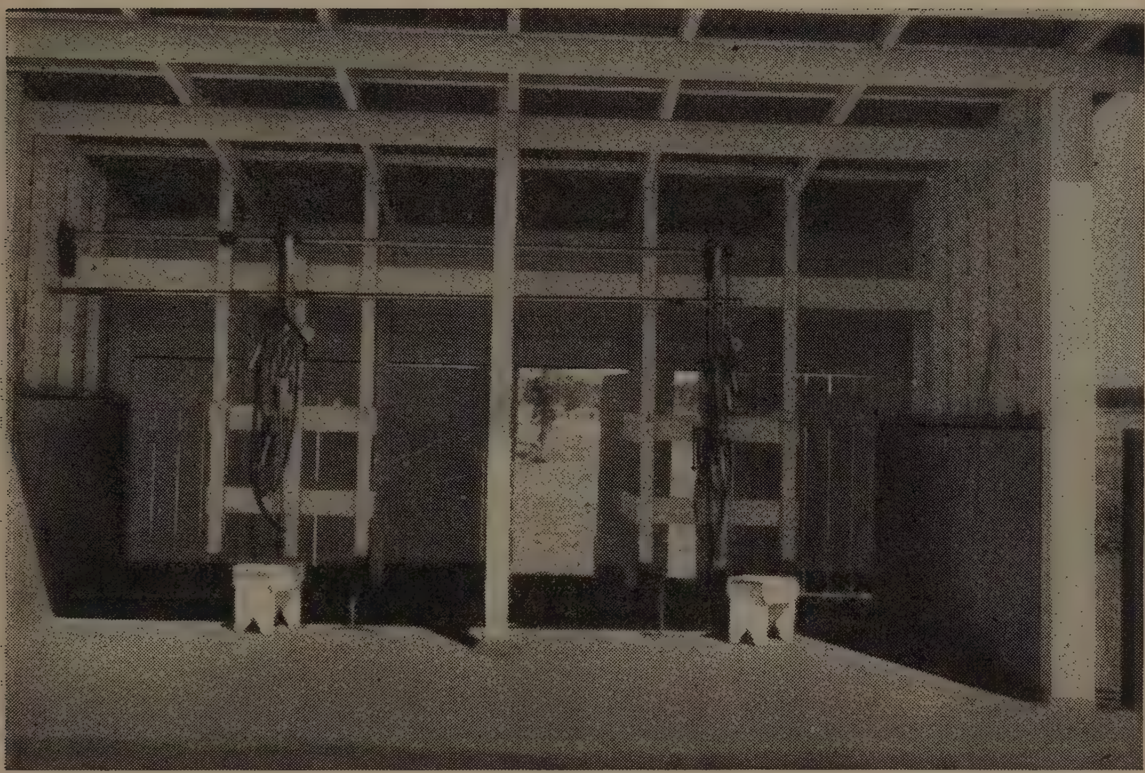


Plate 108.

Interior View of the Bails on a Well-kept Dairy Farm.—Note that the side walls are cemented and finished off with a steel trowel, and that the tops of the end walls are left slanting so that people will not put anything on them.

7. Wash the hands before and as often as necessary during milking. Provide soap, water and towels for this purpose. Practice dry milking. Do not "lubricate" the hands with milk.

8. The sterility of utensils is the most important single factor in dairy hygiene. Thoroughly clean and near-sterilize all utensils after use in the following way:—

(*a*) Immediately after milking, first rinse utensils with plenty of cold water to remove all remnants of milk and cream.

(*b*) Then wash utensils thoroughly (both inside and outside where necessary) with warm water in which washing soda or other cleaner has been dissolved. This makes the utensils physically clean.

(c) Then steam the utensils or immerse them in boiling water. "Scalding," which is the usual final step on most farms, is only efficient if plenty of boiling water is used. The utensils should then be near-sterile.

(*Note.*—For a milking machine, steam is necessary for effective final sterilization. Likewise, in cleaning, at least one gallon of water per unit is required for the preliminary cold water rinse and the hot cleansing solution.)

(*d*) Allow utensils to drain and dry in an inverted position on a metal draining rack situated in a dust-free atmosphere; if desired, the rack may be in a sunny position. Do not use a cloth to dry dairy utensils.

9. Use good quality brushes and not wash-up cloths for cleaning of dairy equipment. Wash the brushes daily after use.

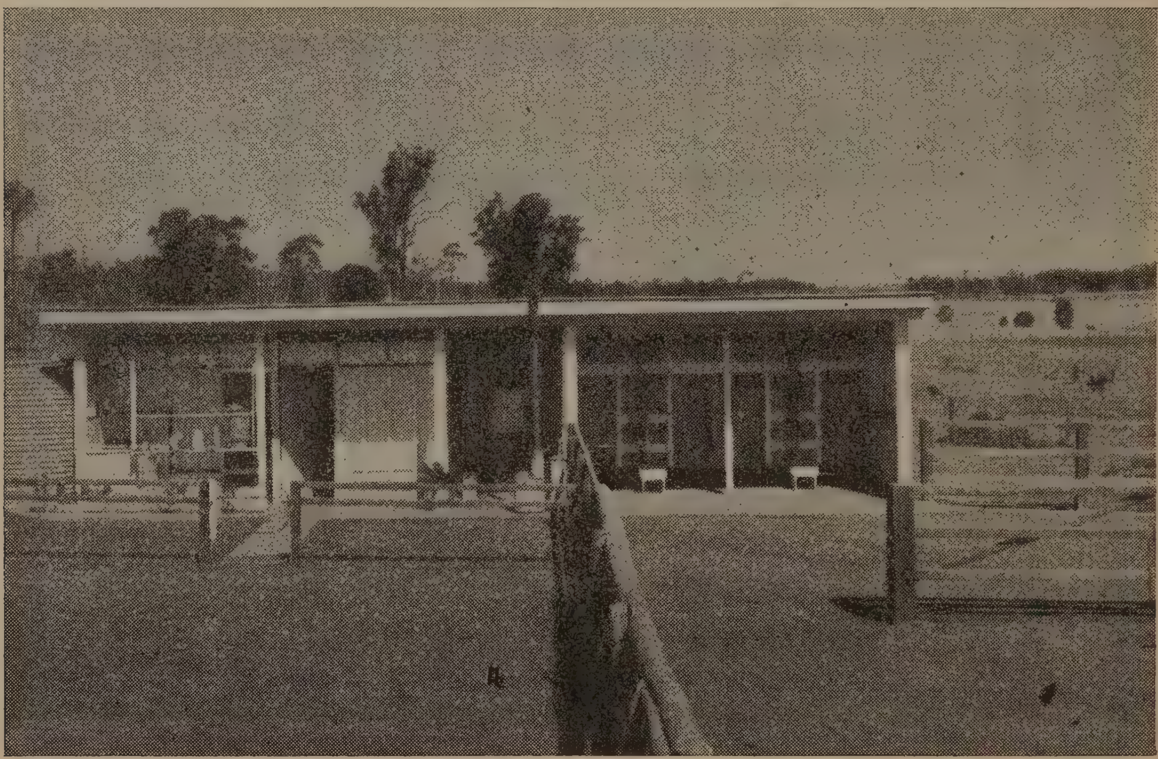


Plate 109.

Well Laid Out Dairy Premises and Yards.—Note the well-kept lawns around the dairy, the suspended bails, and the pipe rack for holding and sunning dairy utensils.

10. In addition to the daily cleaning procedure, dismantle and thoroughly clean and sterilize the milking machine once every week.

11. Flush out and effectively steam at least once weekly the airline of the milking machine.

12. Immediately after separation, cool cream to as low a temperature as practicable and make every effort to keep it cool until despatched to factory.

13. The proper blending of cream from different milkings is important. Do not mix warm with cold cream until the animal heat has been removed.

14. Unless held at a low temperature in a refrigerator, stir cream with a metal stirrer from time to time while it is held on the farm.

15. Thoroughly cleanse all cream cans returned from the factory before again using them for cream.

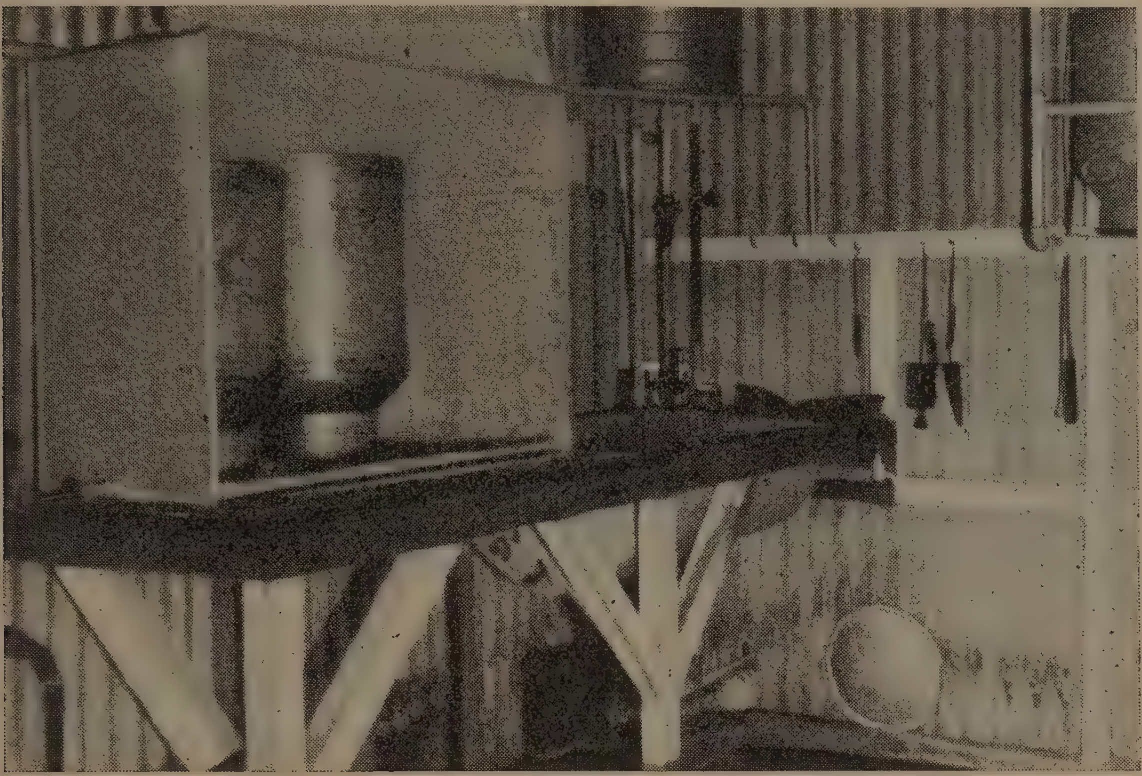


Plate 110.

A Farm Cream Can Sterilizer.—The sterilizer holds three 8-gallon cans at a time. Note that hot and cold water are laid on to the wash-up trough.

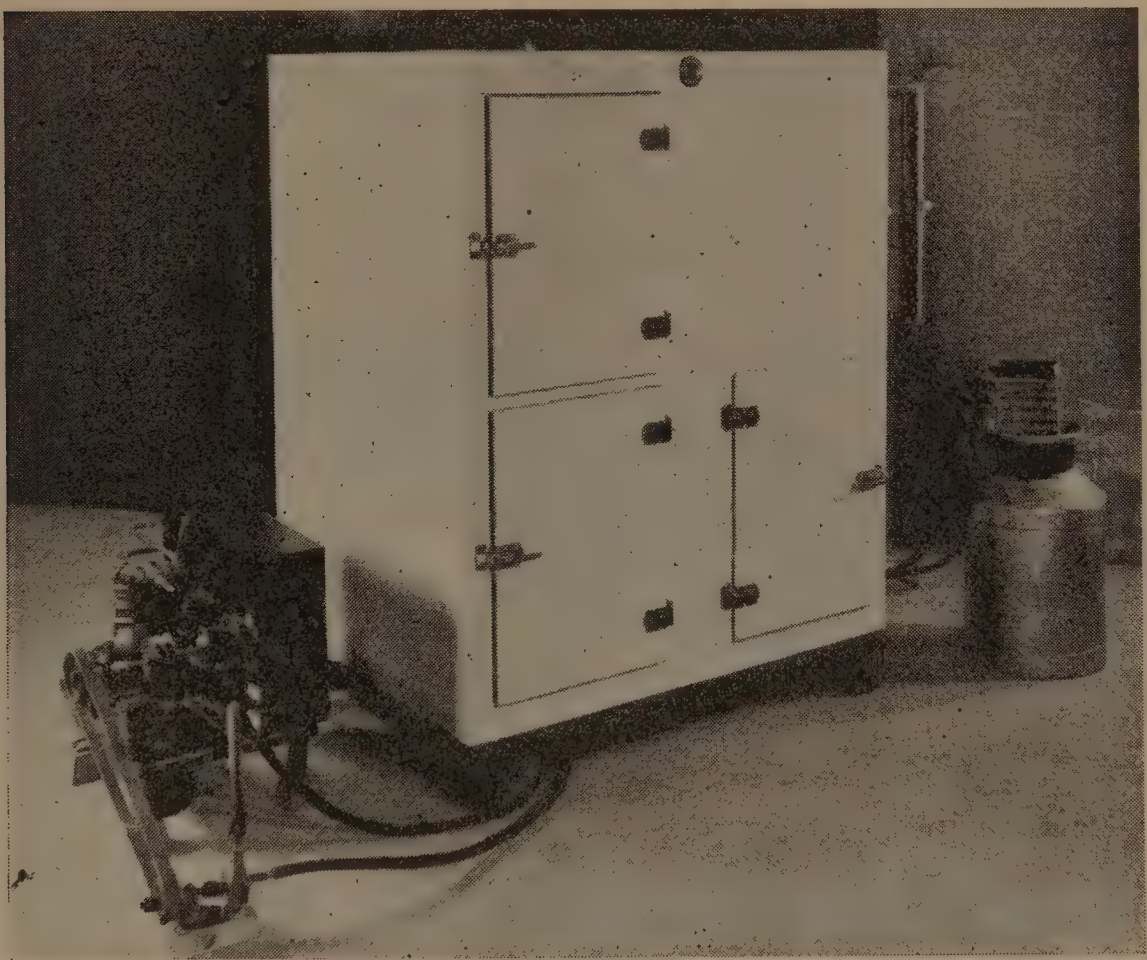


Plate 111.

A Farm Cream Refrigerator Unit.—Note the small cooler through which water is circulated to cool the cream as it enters the can. The cans of cooled cream are then held in the refrigerator cabinet.

16. Adjust the cream screw on the separator to give cream of a 40 to 44 test in summer, and at least a 36 test in winter.

17. Send cream to the factory as often as practicable. The objective in the summer should be daily delivery.

18. Maintain cream cans, all other utensils and equipment in good repair, and, when necessary, promptly make renewals or have the cans retinned. Renew milking machine rubberware as necessary.

19. Sweep and wash down the floor of the bails daily. Spreading lime on the floor is a good practice.

20. Remove manure from the cowyard daily and endeavour to abate the dust nuisance.

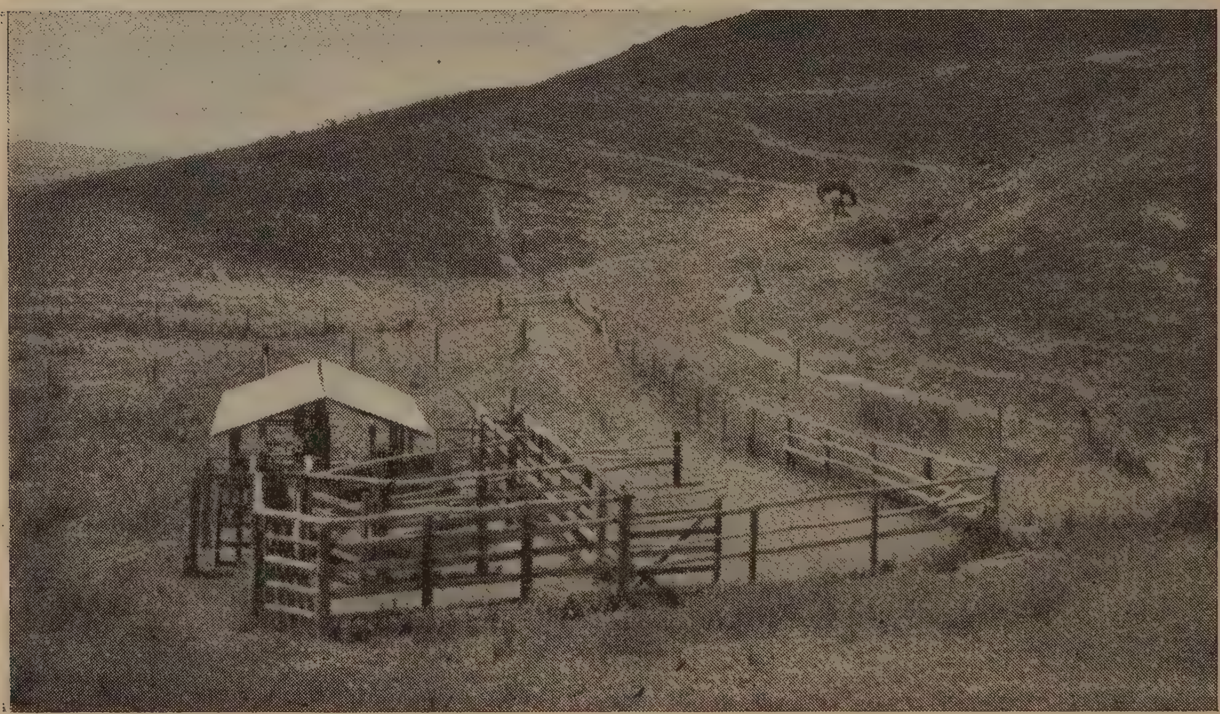
21. Keep the milking shed and dairy tidy. As required, repaint and limewash buildings. Use the dairy house exclusively for dairy produce and not as a general storeroom.

22. Protect dairy produce at all times against contamination from flies, dust, odoriferous substances, and exposure to direct sunlight.

23. Kindness in "breaking in" a heifer repays itself by the behaviour of the animal throughout its milking life. Do not tolerate noise or rough handling of animals in the milking shed. Nervous or fractious cows are detrimental to cleanly shed practices.

24. Do not "set" dogs on dairy stock.

25. If milk-tainting fodders, such as lucerne, are being used, they should be fed after milking and the milkers removed to pasture at least three hours before the next milking period.



Weighbridge and Yards for Experimental Cattle at the Bureau of Tropical Agriculture, South Johnstone.

The Sheep Blowfly Problem in Queensland.

1. Blowflies and Their Breeding Habits.
2. Blowflies in Relation to Their Environment.

G. R. MOULE, Director of Sheep Husbandry.

Introduction.

NEARLY fifty years have elapsed since blowflies affecting sheep first appeared in Queensland, and during that time they have caused serious losses to the sheep industry. These losses must be measured in terms of dead sheep, lowered lambmarking percentages, lower cuts per head, lower wool prices, the cost of dressings and dips, higher labour charges, and increased worry to wool growers. It is not surprising therefore that a considerable amount of research work has been undertaken all over Australia in an effort to control blowfly strike in sheep.

The word "control" is often used in different ways, particularly in relation to blowfly strike. The complete control of blowflies—that is, the absolute prevention of fly strike—would be extremely difficult to attain, and even if it were possible it may be far too expensive to contemplate. On the other hand it is possible, without the expenditure of a large amount of money and time, to reduce fly strike to such a low incidence that it ceases to be of major importance to the industry or to individual property owners.

At least some of the methods which can be used by the industry to control blowfly strike are fairly well known by wool growers. However, it is surprising that so many pastoralists do not appreciate that the most satisfactory results will be obtained by working to a definite plan, which aims at anticipating the times when blowflies will be active, and at taking reasonable precautionary measures to prevent strike amongst flocks.

These articles aim at acquainting wool growers in Queensland with the nature and extent of the blowfly problem and with the background to the control measures which might be employed.

1. Blowflies and Their Breeding Habits.

THE BLOWFLIES CONCERNED IN STRIKE.

There is a large number of different kinds of blowflies, but not every species attacks sheep. Most blowflies are attracted by the odours of putrefaction and for that reason they are to be found on or about carcases.

There are about a dozen different kinds of blowflies which attack sheep in Australia, and these have been classified depending upon their ability to initiate a fresh strike or to invade a strike which has already become established. The flies which are capable of initiating strike are referred to as primary flies, and they include the common green blowfly (*Lucilia cuprina*) and the brown blowflies (*Calliphora stygia* and *Calliphora augur*).

The flies whose maggots invade a strike which is already established are called secondary flies, and amongst these are the secondary green blowfly (*Chrysomyia rufifacies*) and the steel-blue blowfly (*Chrysomyia micropogon*).

Some flies are attracted to wounds or carcases only after the maggots of the secondary flies have become established. These are known as tertiary flies, but they are not of very great importance in Queensland.

The Primary Blowflies.

The common green blowfly, which is the most important primary fly in Queensland, is medium sized and about five-sixteenths of an inch long. It is a bright metallic green in colour, and sometimes has a golden or bronzy sheen. The back of the chest is covered with strong black bristles and some short fine bristly hairs occur on the abdomen, which is short and tapering. The legs are black except for the thighs of the front pair, which are bright green. The maggots which hatch from the eggs laid by this fly are creamy coloured, though some have a faint pinkish tinge. Their bodies are perfectly smooth.

The brown blowflies are commonly referred to as the large brown blowfly and the small brown blowfly. The large brown blowfly (*Calliphora stygia*) is a very robust fly, measuring up to half an inch in length. It buzzes furiously and occurs commonly in houses in eastern Australia. Its eyes, abdomen, and legs are brown in colour; its thorax, which is slaty grey, carries large black bristles. Fine golden hairs occur on the under and upper side of the abdomen.

The small brown blowfly (*Calliphora augur*) also occurs in houses in eastern Australia. It is smaller than the large brown blowfly. Its eyes and thorax are similar in colouring to those of the large brown fly, but the abdomen, which is yellowish brown, carries a dark steel-blue patch in the centre.

The Secondary Blowflies.

The three most important secondary blowflies are the secondary green blowfly or large hairy maggot blowfly (*Chrysomyia rufifacies*), the small green blowfly or small hairy maggot blowfly (*Microcalliphora varipes*) and the steel-blue blowfly (*Chrysomyia micropogon*).

The secondary green blowfly is often mistaken for the primary green blowfly, as they are about the same size and of similar colour. However, the secondary green fly has a bluish tinge at the base of the abdomen and on its underside, and dark bands cross the abdomen at the junction of the segments.

The maggots which hatch from the eggs laid by this fly are well known as "hairy maggots." They are large and vigorous, brownish grey in colour, and furnished with a number of fleshy processes which differentiate them easily from the smooth maggots of the primary flies.

The small green blowfly is quite similar in colouring to other green flies, but it is much smaller, being only about half the size of the other blowflies which commonly attack sheep. Its maggot is also rough like that of the large hairy maggot blowfly, but it is somewhat smaller and pale brown in colour.

The steel-blue blowfly is a broad robust fly, slightly less than half an inch in length. It is a dark steel-blue colour, though it has a tinge of green when alive. Unlike those of the other secondary flies, its maggots are smooth and cream coloured.

THE LIFE CYCLE OF BLOWFLIES.

All blowflies pass through four distinct stages—the egg, the maggot, the pupa, and the adult fly. Of these the second or maggot stage is most important to the sheep man, because the maggots parasitise sheep. The maggot stage is also of particular importance in the development of blowflies. Insufficient nourishment in this stage will result either in the death of the maggots or, if they survive, in the production of undersized adult flies.

The eggs of the different species of blowflies resemble one another and it is extremely difficult to differentiate them. They are creamy white in colour and are shaped somewhat like a banana. They are laid either singly or in clusters, and adhere by means of a sticky solution.

Except in very cold weather, blowfly eggs hatch in from one to two days. The average time of hatching for the green blowfly's eggs is twenty-four hours. The maggots which hatch from the eggs are of two distinct types and are commonly referred to as being either smooth or hairy. All the blowflies affecting sheep in Queensland have smooth maggots except the secondary green blowflies. The maggots are elongate grubs, for the most part cylindrical in shape, but they taper markedly towards the head end. The mouth is on the underside of the head, and the jaws can be extruded through it, in the form of two parallel black hooks.

The fully fed hairy maggot of the larger secondary green fly is slightly larger than the smooth maggot, and the effect of hairiness is produced by a number of fleshy processes, which bear clusters of minute spines at their tips. The mouth hooks are very strongly formed, stout, and sharply pointed, and used in attacks on other maggots.

The maggots of both primary and secondary flies pass through quite well defined stages before they become fully fed. The important thing to remember is that the first and second stages are passed quickly, usually within a day or so of hatching, and once a maggot has passed into its third stage of development it may be capable of completing its life cycle.

When feeding, primary maggots burrow their way into their food with their heads, tearing the flesh with their mouth hooks. Most of the food appears to be taken in liquid form, though very fine particles of solid matter may also be swallowed.

The large hairy maggot feeds both on carrion and on living smooth maggots. It should be regarded as one of the most important enemies of all primary maggots, as it devours smooth maggots and because of its superior strength usually takes heavy toll of the smooth maggots established in any strike.

It is essential to remember that the large hairy maggots cannot, under normal circumstances, obtain a footing on living sheep unless strike has already been initiated by primary smooth maggots.

When the maggots are fully fed they commence to wander, apparently in search of a suitable place to pupate. A number of factors influence the duration of the wandering stage, and these include temperature and humidity. If the sheep does not succumb as the result of being struck, the maggots drop to the ground, where they may continue wandering until they find some spot suitable for pupation. Even in dry weather some maggots have been observed to travel a horizontal distance of 10 feet through fairly compact soil on the bank of a creek.

Pupation, which is the next stage in the blowfly's life cycle, can be regarded as a period of rest, during which definite developmental changes take place. As pupation commences the maggot's skin, which becomes thick and tough, forms a protective coat. This finally assumes the shape of a barrel, and becomes dark and hard. The delicate tissues within are gradually broken down and reformed into the adult fly.

When the adult fly is ready to emerge it sheds its delicate pupal skin, and gradually forces the top of its protective shell. The fly then works its way out into the soil and eventually reaches the surface. Flies have been observed to have worked their way up from pupae buried 3½ feet below the surface.

When the newly emerged fly appears on the surface of the soil it runs about until its wings are fully expanded and its body is fully coloured and hard. It then flies off in search of food.

THE POWER OF INCREASE OF BLOWFLIES.

The ability of blowflies to increase in numbers depends upon the rapidity with which the life cycle is completed and also upon the average number of progeny produced.

The Duration of the Life Cycle.

The time taken to develop from the egg to the adult fly depends chiefly upon the weather. Development is more rapid in warm, moist weather than it is in cold. The steel-blue blowfly, which is a tropical and sub-tropical species, is the quickest to develop of any of the blowflies so far studied. It averages seven days from the laying of the egg to the emergence of the adult fly. It takes about another three days for the female fly to become sexually mature, making a total of ten days from egg to egg. The female fly lives for a month or more and is capable of depositing eggs over most of that period.

The Number of Progeny.

The largest number of adult progeny obtained from a single blowfly under insectary conditions was over 2,000. The average number has been well over 1,000. Allowing that one-half of the flies produced will be females, this means a 500-fold increase in each generation. Assuming 1,000 blowflies weigh an ounce, a pair (male and female) of the most prolific steel-blue blowflies could produce enough offspring in eleven months to equal the weight of the whole world!

It is very difficult to eradicate parasites which have such a tremendous power of increase, unless steps can be taken to destroy the flies' breeding ground and this is one of the most important objects in modern blowfly control measures.

2. Blowflies in Relation to their Environment.

Two environments must be considered in studying the effects of environment upon the blowflies affecting sheep. They are :—

(1) The external environment to which the adult flies are exposed.

(2) The environment available to the blowfly maggots.

A good deal of work has been undertaken in studying both of these environments and because of their relative importance each one is discussed in this section.

THE GEOGRAPHICAL AND SEASONAL DISTRIBUTION OF FLIES.

The distribution of the primary green blowflies (*Lucilia*) strongly suggests that they were imported into Australia. *Lucilia cuprina,* which is chiefly responsible for primary strike of sheep in Queensland, is essentially an inland species. It occurs at Julia Creek in the north-west of the State and extends as far south as Albury and adjacent districts in northern Victoria.

The numbers of primary green blowflies which are present vary with the seasonal conditions. In warm climates, such as those in Queensland, there are two well defined periods when they are prevalent:—

(1) During the autumn months of April and May.

(2) During the spring and early summer months of August, September, October and November.

The secondary green blowflies are both native Australian species and they have a very wide distribution. They are both essentially summer flies. In southern Queensland they are prevalent in the spring and autumn, while in tropical Queensland they can be found practically all the year round.

The steel-blue fly is also a tropical and sub-tropical species and it occurs practically throughout the year.

The brown blowflies are the outstanding members of the blowfly family throughout southern Australia. In warmer sub-tropical climates, however, they become purely a winter species.

Temperature is the most important single climatic factor affecting the activity and fertility of adult flies. The common primary green blowfly is most active in air temperatures of 80 deg. F. when exposed to temperatures which are kept constant. If air temperatures are rising they are most active at or about 68 deg. F. Other species—for example, the large brown blowfly—are more active at lower temperatures, and are not as active as the primary green blowfly at higher temperatures. Temperatures as low as 60 deg. F. depress the rate at which female flies lay their eggs.

The long hot summers experienced in north-western Queensland greatly reduce blowfly activity in that area. It is not uncommon for maximum temperatures to exceed 100 deg. F. in April, and hot spells sometimes extend to May. They commence again in October. This tends to restrict blowfly activity to the early winter and early spring months. In the southern part of the State where conditions are more equable the usual autumn and spring waves are easily recognised.

Wide ranges of relative humidity, from 15 per cent. to 100 per cent., do not produce any observable effects on the adult flies. Most of the species that occur in Australia are most active in bright sunlight, but there is evidence that the common green blowfly is active in dull as well as in sunny weather. This is important, as it is in showery, sultry weather that sheep are most susceptible to attack.

Cold weather also decreases blowfly activity. This is of particular importance in the Stanthorpe, Mitchell and Tambo districts, which usually experience colder winter conditions than other parts of the sheep country. It is usually safe to say that in Queensland frosty weather reduces fly strike, and the cold dry southerly winds which blow sometimes in winter over the open Mitchell grass downs country usually curtail blowfly activity very quickly.

THE ENVIRONMENT AVAILABLE TO THE BLOWFLY MAGGOTS.

Most people know that blowflies breed in carrion. While this generalisation is true for many varieties of blowfly it does not apply fully to those varieties which parasitize sheep.

Carrion passes through definite stages of decomposition, and each is occupied by the maggots of particular species of flies. The primary green flies and the brown flies come first, and after their maggots are established they are followed by secondary flies.

In the earliest stages there is ample room for the young primary maggots, but as they grow intense competition occurs for the available food and space.

When the vigorous, rapidly growing, voracious hairy maggots of the secondary flies arrive, competition becomes more intense. As the secondary maggots devour the smooth primaries they suffer badly from these attacks and the lack of space and food. Half a sheep carcase,

which was protected from further attack after the primary flies had laid their eggs, produced 14,300 primary flies. In the other half of the carcase the secondary flies were allowed to strike on top of the primaries. Only 87 primary flies hatched.

There is an assortment of beetles and wasps which invade the carcase in its complete stages of decomposition and parasitize blowfly maggots and pupae.

Climate also affects the development of the maggots in carrion. In hot weather the hairy maggots grow very rapidly and the first stage of decomposition of a carcase may last only 24 hours. This increases the competition which the primary maggots must meet, and few survive. In cool weather, however, the brown fly's maggots grow better than the hairy maggots and in addition decomposition is prolonged. This gives the primary maggots a chance to complete their development and devour most of the carcase before they are displaced.

The realisation that so few primary flies are produced from a carcase led to a comparison between the live sheep and carrion as a breeding ground for sheep blowflies.

Sheep do present a special environment for blowfly maggots, and as a result they exert a profound influence on fly populations. The following points summarise the way in which this occurs :—

(1) The sheep is particularly attractive to the common green blowfly and consequently the maggots of this species are dominant as primaries in strikes, even in districts where adult flies of the species constitute as little as 1 per cent. of blowfly population.

(2) The susceptible sheep provide shelter favourable to maggots, as well as optimum temperature and moisture conditions. However, they do not provide quite as much food.

(3) The hairy maggots only attack a portion of the struck sheep, and even on these do not displace the primaries as effectively as they do on carrion.

(4) The maggots are not so crowded on the large sheep as they are on carrion.

(5) Maggots on struck sheep are free from other parasites which attack them.

This results in a higher survival of primary green fly maggots on struck sheep than on carrion. As many as 1,700 adult green blowflies were bred from an extensive natural breech strike, whereas seldom more than 100 emerge from a carcase.

The practical applications of this information are clear :—

(1) It is futile to prevent flies breeding in dead animals, when crutchings from struck sheep are left about so that maggots can complete their development.

(2) Fly waves build up as the result of flies breeding in struck sheep. In all control measures it is essential to prevent a high incidence of strike developing amongst the sheep in any flock. This leads to rapid increases in fly populations.

Beef Cattle Production on Some of the Gulf Watersheds.

J. C. J. MAUNDER.

[*Continued from page* 60 *of the January issue.*]

STOCK ROUTES.

The main arterial stock routes that carry the regular store movements from the Gilbert and Mitchell country were investigated to determine (*a*) the type of country through which cattle travel, (*b*) existing water facilities, (*c*) numbers of cattle using the routes, (*d*) origin and destination of movements, and (*e*) watering facilities required to improve the routes. Some of this information was obtained by discussions with owners, managers, drovers and stockmen, some by personal observation; most of it was collected by the District Inspector of Stock (Mr. N. C. Copeman).

(1) Gilbert River Stock Route.

The route follows the river frontage country of the Gilbert and Einasleigh, through Miranda Downs, Strathmore, Abingdon Downs to Dagworth, Talaroo, thence through Einasleigh, Carpentaria Downs, Lyndhurst, and on to the fattening country of the Burdekin basin.

As far as Dagworth, the country is flat, devoid of stone and usually carries a good body of feed from April to the end of September. Sometimes a shortage occurs in November and December, especially when fires have wiped out a lot of dry feed and where storms have been "patchy." There is some stone in the vicinity of Talaroo on the Talaroo-Einasleigh stage, but generally speaking the whole route is good.

This route not only carries all the cattle from the Gilbert area, but is also used by cattle from Magoura and Croydon and by some small Georgetown mobs. Approximately 20,000 head per annum would use the main Gilbert River via Abingdon Downs to Einasleigh route.

The existing natural water supplies are usually adequate for normal travelling seasons and consist of large permanent "holes" in the Gilbert and Einasleigh Rivers and "off river" lagoons. The weakest part of the route is from Talaroo to Einasleigh. There are no artificial watering facilities on any part of the route.

The gazetted stock route through Forest Home and Georgetown and over the Newcastle Range into Einasleigh, known as "Hell's Gate Road," is practically unused, being short of feed, almost devoid of water, and traversing rough, steep and stony country. Even if water were to be made on this route, it is doubtful if it would be used to any extent.

(2) Mitchell River and Van Rook Connecting Routes.

The main Mitchell route follows the frontage country of the Mitchell and passes through Dunbar, Highbury, Gamboola, Walsh Telegraph Station and Wrotham Park, thence through Rookwood to Mungana, Chillagoe and Alma-den. Many cattle are trucked at Mungana, while most of the remainder walk through Chillagoe and Alma-den to Fossilbrook, Mount Surprise, Rosella Plains and Spring Creek to fattening properties in the Mount Surprise and Burdekin basin districts.

Plate 112.

A Typical Homestead in the Gulf Area.

The route connecting the Mitchell and Gilbert routes passes through Dunbar and Van Rook and up Echo Creek to join the Gilbert route near Minnies Lagoon (Strathmore) on the Einasleigh.

The main Mitchell route as far as Nolan Creek (Wrotham Park) carries a good body of feed and traverses flat country free of stone. Storms and fires affect the feed position, as for the Gilbert. From Nolan Creek the going becomes slightly rougher with more stone, especially through Mungana, Chillagoe, Alma-den and on to Fossilbrook. However, the route, even over these stoniest sections, cannot be regarded as difficult. Over this section feed is not so good as through the Mitchell frontage country.

The connecting route, Dunbar-Van Rook, is through flat forest country which provides easy travelling with ample feed of low nutritive value. There is no stone.

The main Mitchell route carries cattle from the Gulf and western and lower Peninsula areas for trucking at Mungana or fattening on properties in the Mount Surprise and Burdekin basin districts. The numbers are approximately 18,000 per annum; 9,000-10,000 of these are trucked at Mungana.

The connecting route carries Dunbar cattle (including purchases from the Mission) in those seasons when they do not use the main Mitchell route, and is therefore only an alternative one. The numbers average approximately 2,000-4,000 head per annum.

The connecting route, and the main Mitchell route as far as the Walsh Telegraph office, are adequately watered, with permanent "holes" in the river and permanent "off-river" lagoons. The main route from the Walsh Telegraph Station onwards is not well watered. There are no artificial watering facilities on either route.

(3) Einasleigh–Mount Surprise–Alma-den Route.

This route in the past provided an outlet for approximately 2,000 head of Einasleigh and Kidston cattle for trucking at Alma-den or Tumoulin. When Mount Surprise is opened as a trucking centre, the majority of these cattle will probably be trucked there for removal to Mareeba saleyards or slaughter yards and meatworks.

This route provides reasonable travelling conditions but is reported to require a permanent watering facility at Sandy Creek, approximately half-way between where it leaves the Einasleigh river and Quartz Hill, where there is permanent water in Elizabeth Creek.

In the past, a yearly total of approximately 4,000 head of cattle from the Kidston, Einasleigh, Georgetown and Mount Surprise areas used this route for trucking at Alma-den to meatworks or coastal fattening properties, but with the opening of the Mount Surprise–Alma-den line for cattle trains practically all these cattle would be trucked at Mount Surprise and this route should then only be used by approximately 2,000 head from Strathgordon and Strathburn, travelling to Strathfield, approximately 500 head from Mount Mulgrave, travelling to Mount Surprise Station, and approximately 2,500 head from Dunbar which at times travel this route via Mount Surprise, Rosella and Spring Creek to the Valley of Lagoons stations. It is also considered that some of these cattle may be trucked from Mungana via Alma-den to Mount Surprise, as this route is reported to be very stony in places and causes considerable lameness in cattle.

(4) Gilbert River–Georgetown–Talaroo Route.

This route provides reasonably good travelling conditions for the removal of the majority of cattle from the Georgetown and Gilbert River areas above Forest Home to their normal markets, with the exception of a bad stony and steep stage over the Newcastle Range which, according to experienced drovers, can be avoided to a great extent by diverting from the gazetted route on top of the Newcastle Range and going north to the Old Shamrock Pad, thence down the range and north-east to Talaroo.

From the above, it will be seen that stock routes are fairly good, and it is not until cattle leave the eastern fringe of the Gulf area that travelling conditions and water supplies are a problem.

DISEASE CONTROL PROBLEMS.

Cattle ticks and buffalo fly are factors limiting production, while mineral deficiencies, contagious pleuro-pneumonia, tick fever and mortalities in calves are all of some consequence. There is some trouble with poison plants, and horses are troubled with Kimberley and/or Birdsville disease and worm infestations.

Cattle Ticks and Tick Fever.

At the time of the visit (September, 1949), cattle ticks were bad on the Mitchell country from the Walsh to about 100 miles down the Mitchell. From there to the coast, the tick population gradually decreased, and in the coastal country infestations were very light.

It is significant that there are fewer dips in the coastal country than further inland; furthermore, managers there do not appear to be so concerned about tick control as managers of places further up the rivers.

Plate 113.

A Strategic Dip at Minnies Lagoon Charged with DDT.

Beyond this coastal strip, there is no doubt that cattle tick control is one of the big problems of the area. Yards and dips are insufficient to handle the large herds dispersed over a wide area of unfenced country. Cattle are never mustered solely for dipping purposes and tick control is effected simply by putting cattle through the dip when they are yarded in the course of ordinary mustering. This means that cattle are probably dipped only twice a year and at most three times. With arsenical dippings, it will be appreciated that this is quite inadequate.

Tick fever does not occur in the permanently infested areas, but there is a considerable amount of marginal country around Croydon, the Gregory Range and the Georgetown district. Cattle from those areas have to travel through ticky country to their outlets and tick fever is fairly common in travelling mobs from these districts. Protective

inoculation is sometimes practised and attempts are being made to prevent outbreaks by the use of DDT dipping. Some cases of tick fever have also occurred from time to time in cattle from the coastal strip.

There is no doubt that the control of ticks and tick fever is a difficult problem, especially under the conditions of herd management practised. The rational use of inoculation and dipping in DDT, depending on circumstances pertaining at different places, at least provides two possible ways of dealing with the problem. How and when to apply them, and which to select, can only be decided on the spot.

The use of breeds of cattle resistant to cattle tick and buffalo fly would go a long way towards solving the problem of these two pests.

Buffalo Fly.

Buffalo fly probably does more to restrict growth and production than is generally realised. Although the cattle bred in the area appear to have developed some tolerance, bulls generally are more affected and introduced bulls are unable to work at full capacity owing to buffalo fly worry. Horses are troubled a lot and would work better if they were not irritated by the fly.

Although most stations realise the value of DDT for buffalo fly control, it is extremely difficult to apply control measures under their conditions of management. Some attempts are being made to alleviate the trouble in horses by spraying them in the mustering camps.

Contagious Pleuro-pneumonia.

The area has a bad name for pleuro-pneumonia and has long been regarded as a reservoir of infection from which the disease is spread throughout the State by means of stores purchased from the Gulf and dispersed throughout fattening areas.

No doubt there is some pleuro, but it may not be nearly as bad as imagined. The incidence is certainly lower here than in the cattle country of the Gregory, Leichhardt, Flinders and Saxby. Bullocks are usually vaccinated prior to going on the road, and there are few reports of outbreaks of pleuro amongst travelling mobs from the area. Any holding on which pleuro is known to exist would be well advised to adopt a routine policy of vaccination of yearlings, with a second vaccination before going on the road.

Malnutrition.

The fact that the pastures decrease in nutritive value from July to November, by which time they have very little value, is the biggest single factor limiting production in the area. Calves that are dropped during the worst of this period have a struggle to survive owing to the fact that their mothers can produce little or no milk on the poor type of feed available. As a result, losses may be quite heavy, especially with male calves that suffer the additional setback of castration. It appears that bone chewing is present throughout the area, as would be expected in country of apparently low soil fertility and fairly high rainfall. Soil phosphate values of samples taken at various places are given in Table 2.

No attempt is made to supply mineral supplements, and it is impossible to suggest a practicable and economical method of doing so. Salt-bonemeal mixtures could be put out in troughs around the permanent watering places, but there would be no way of ensuring that the

cattle consumed sufficient but not excessive quantities. Wastage of material would be high, and as freight charges would make the supplements very expensive, it is probable that attempts to feed them would prove to be uneconomical. However, there is little doubt that bonemeal feeding, if it could be practised, and provided the economics were sound, would produce worthwhile results. There is no evidence of botulism.

TABLE 2.

PHOSPHATE CONTENT OF SOILS.

Area.	Soil Type.	Phosphate (p.p.m. P_2O_5).	Remarks.
1. Mt. Surprise	Black soil plain	121	On alluvial soils, lucerne, onions and cereal crops are grown successfully
	Brown soil	496	Brown soil is representative of the bulk of the holding which is on the edge of the basalt country and fattens good bullocks
	Alluvial wash	764	
2. Einasleigh	Alluvial ..	250	Adjoins No. 1 holding—lucerne is grown on this alluvial, but does not look as well as No. 1
3. Einasleigh	" Off river "	43	Sample taken west of Einasleigh—the change from good to inferior country is rapid, as indicated by areas 1, 2 and 3
4. Gilbert River	Alluvial ..	50	The alluvial is typical of frontage; " off river" is forest of slightly better appearance than much of the forest country of the area
	" Off river "	43	
5. Van Rook	Bauhinia plain	107	Sample taken from a bauhinia plain between the Gilbert and Middle Creek. It carried a good body of grasses and was the best looking country seen in the Gilbert-Mitchell area
6. Staaten	Alluvial ..	25	This is the poor country of the Staaten and Red River, where true frontage is almost absent; gutta percha and tea-tree forest dominate the picture
	" Off river "	19	
7. Mitchell	Alluvial ..	41	The frontage looks reasonably good and carries most of the cattle. The forest (" off river ") is very poor in appearance
	" Off river "	28	

Miscellaneous Diseases.

It is unlikely that any considerable losses occur in cattle due to any disease conditions other than those previously mentioned. Some mortalities do occur in travelling stock, but generally speaking, the country appears to be reasonably free of poison plants.

Horses seem to do quite well, but it is possible that they carry a fair worm burden and would benefit from routine phenothiazine treatments. Reports of managers suggest that fairly heavy losses occur from so-called "Gilbert River disease," which is probably identical with Kimberley horse disease. There is evidence to suggest that the condition occurs in some areas where there is practically no whitewood, and does not occur in other areas where whitewood is plentiful.

TRANSPORT AND COMMUNICATIONS.

Being a remote area, it cannot be expected that transport and general communication would be very good, but the advent of aerial services has greatly improved conditions.

Some supplies come from Cairns by rail to Forsayth, thence by the Forsayth-Croydon road transport. Another route is by ship to Normanton, thence by road transport, or rail to Croydon, thence by road.

A weekly aerial service between Cairns and Normanton includes a circuit of the main stations, each of which has a landing strip authorised for use by the Department of Civil Aviation.

Stations are served by radio circuit and have the benefit of the very excellent service provided by the Cairns aerial ambulance. Two qualified nursing sisters are maintained at the hospital at Dunbar and one at the Mitchell River Mission.

During the wet season, most of the stations are inaccessible to road transport for a period of anything up to three months, but aerial services can usually be maintained.

GENERAL CONCLUSIONS.

One is somewhat diffident about reaching conclusions as a result of a comparatively short investigation, but some of the impressions received are set down here as a matter of interest.

(1) *Low Fertility of Forest Country.*—The bulk of the area is comprised of poor forest country, provided with ample water but capable of running only about two beasts to the square mile. It is subject to flooding; during the wet season it becomes very boggy, and the few cattle running there are forced on to frontage country and low sandy ridges.

(2) *Potentialities of Frontage Country.*—The carrying capacity of a holding is determined by the ratio of frontage to forest, the former carrying practically all the cattle. Though the frontages grow pastures which support a fairly heavy cattle population, it is doubtful whether the soils are physically and chemically suitable for the growth of supplementary fodder crops.

(3) *Potentialities of Coastal Country.*—In planned development of the area, the coastal strip extending about 20 to 30 miles inland should receive prior consideration. With its adequate rainfall, safe water supplies and apparently better soil types, it has the general appearance of country awaiting development. It is not, however, an undeveloped fertile area simply awaiting settlement, but rather gives the impression of country that requires scientific development to take full advantage of its potentialities and to make good its deficiencies.

(4) *Essentially Cattle Country.*—Any development of the country to increase its productivity should have as its objective the creation of an adequate reservoir in which large numbers of cattle can be bred to provide stores for fattening in the more favoured areas of North Queensland. That such a reservoir should be established and improved is of vital importance to the beef cattle industry.

(5) *Cattle Breeds and Environment.*—The environment of this tropical area, which subjects cattle to the hardships of cattle tick and buffalo fly and existence for five months of the year on grasses of low

nutritive value with practically no assistance from edible trees, shrubs or herbage, makes considerable demands on the adaptability of cattle. It demands much skill on the part of cattle breeders to develop a type suitable to the environment and makes equally great demands on the ingenuity of management to get the best out of such types.

The fact that no straight British breed has been accepted as the right type, cross-breeding in various combinations being adopted, together with the fact that stores reach the age of 3-4 years before being ready for movement to fattening areas, suggests that the breeders and managers are only holding their own in this battle against the environment.

The remoteness and nature of the area and the economics of the industry make it very difficult to alter the environment substantially, and therefore one of the fundamental requirements is to produce a beast than can more adequately cope with the environment. It is natural to turn to the Zebu-cross to produce this beast, and from personal observations and opinions of cattle men in the area, it is considered that this type of beast is likely to succeed.

An alternative to the Zebu hybrid is the development of a strain of British cattle that have been produced in the particular environment of this part.

In any plans for development of the country, high priority must be given to the development of a suitable breed to cope with the environment of poor, tropical country carrying coarse grasses of low nutritive value for six months of the year. Either of the above two methods is more likely to succeed than the policy of importing good bulls from vastly different environments.

(6) *Disease Control is Possible.*—It is considered that cattle tick and buffalo fly can be controlled effectively by the use of comparatively resistant types of cattle combined with dipping two or three times yearly in DDT. Even with the present breeds, this treatment would achieve considerable improvement.

Contagious pleuro-pneumonia can be controlled by vaccination, and nutritional disease is once more partly a matter of the beast for the environment.

(7) *Outlet for Cattle is Good.*—There is a good outlet for the stores bred in this area to fattening properties controlled by the same interests, or for sale to fatteners. Stock routes are reasonably good and do not restrict movements. With present store cattle values and with the prevailing pastoral company management policies, there is little likelihood that air-freighting of station-killed beef would be a practicable proposition.

ACKNOWLEDGMENTS.

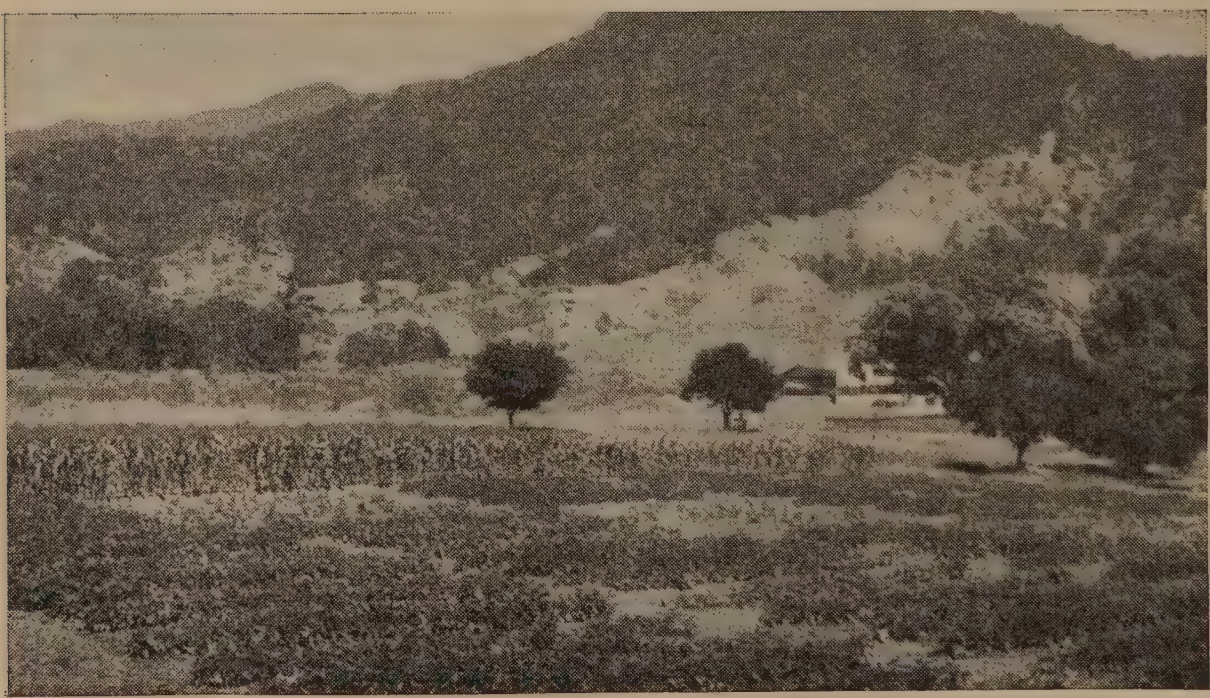
In conclusion, the hospitality and helpful co-operation by all of those fine people of the beef cattle industry with whom contact was made are gratefully acknowledged.

The careful planning and organisation of Mr. N. C. Copeman, District Inspector of Stock, Cairns, who accompanied the writer on his visit, are also recorded with appreciation.

TUBERCULOSIS-FREE CATTLE HERDS

(AS AT 28th FEBRUARY, 1950.)

Breed.	Owner's Name and Address of Stud.
Aberdeen Angus ..	The Scottish Australian Company Ltd., Texas Station, Texas
A.I.S.	F. B. Sullivan, "Fermanagh," Pittsworth D. Sullivan, "Bantry" Stud, Rossvale, *via* Pittsworth W. Henschell, "Yarranvale," Yarranlea Con. O'Sullivan, "Navillus Stud," Greenmount H. V. Littleton, "Wongalea Stud," Hillview, Crow's Nest J. Phillips and Sons, "Sunny View," Kingaroy Sullivan Bros., "Valera" Stud, Pittsworth Reushle Bros., "Reubydale" Stud, Ravensbourne
Ayrshire	L. Holmes, "Benbecula," Yarranlea J. N. Scott, "Auchen Eden," Camp Mountain
Friesian	C. H. Naumann, "Yarrabine Stud," Yarraman J. F. Dudley, "Pasadena," Maleny
Jersey	W. E. O. Meier, "Kingsford Stud," Rosevale, *via* Rosewood J. S. McCarthy, "Glen Erin Jersey Stud," Greenmount J. F. Lau, "Rosallen Jersey Stud," Goombungee G. Harley, Hopewell, Childers Toowoomba Mental Hospital, Willowburn Farm Home for Boys, Westbrook F. J. Cox and Sons, "Rosel" Stud, Crawford, Kingaroy Line R. J. Browne, Hill 60, Yangan P. J. L. Bygrave, "The Craigan Farm," Aspley A. Verrall and Sons, "Coleburn" Stud, Walloon



Trial Plots of Fruits and Vegetables at the Kamerunga Horticultural Station, near Cairns.

ASTRONOMICAL DATA FOR QUEENSLAND.

APRIL.

Supplied by W. J. NEWELL, Hon. Secretary of The Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			MINUTES LATER THAN BRISBANE AT OTHER PLACES.					
Day.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	5·57	5·47	Cairns ..	18	40	Longreach	30	40
6	6·00	5·41	Charleville ..	26	28	Quilpie	36	34
11	6·02	5·36	Cloncurry	42	58	Rockhampton ..	5	15
16	6·05	5·31	Cunnamulla ..	30	28	Roma	16	18
21	6·08	5·26	Dirranbandi ..	20	18	Townsville ..	16	34
26	6·10	5·21	Emerald	14	24	Winton	34	46
30	6·12	5·18	Hughenden ..	27	43	Warwick	5	3

TIMES OF MOONRISE AND MOONSET.

At Brisbane.

Day.	Rise.	Set.
	a.m.	p.m.
1	12·24	2·39
2	1·30	3·19
3	2·34	3·54
4	3·35	4·25
5	4·33	4·55
6	5·30	5·25
7	6·27	5·55
8	7·23	6·27
9	8·21	7·03
10	9·19	7·44
11	10·15	8·29
12	11·10	9·18
	p.m.	
13	12·01	10·12
14	12·47	11·08
15	1·28	..
		a.m.
16	2·05	12·06
17	2·39	1·04
18	3·11	2·03
19	3·43	3·02
20	4·15	4·02
21	4·48	5·04
22	5·26	6·10
23	6·11	7·19
24	7·03	8·31
25	8·02	9·42
26	9·08	10·49
27	10·16	11·47
		p.m.
28	11·23	12·37
29	..	1·19
	a.m.	
30	12·28	1·55

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

Charleville 27; Cunnamulla 29; Dirranbandi 19; Quilpie 35; Roma 17; Warwick 4.

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Day.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	29	12	45	26	20	1	52	29
6	18	22	33	38	9	13	38	43
11	9	30	25	45	0	21	26	54
16	12	28	27	43	2	19	30	51
21	23	16	39	31	14	7	45	36
26	30	9	46	23	21	0	54	26
30	23	14	39	30	14	5	45	34

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	29	12	45	26	20	1	44	6
3	24	15	41	30	16	6	35	17
5	19	19	36	35	10	10	25	25
7	15	24	30	40	6	15	17	34
9	12	28	27	43	2	19	9	42
11	9	30	25	45	0	21	4	46
13	9	30	25	45	0	21	3	46
15	11	28	26	43	0	19	7	41
17	14	35	29	41	4	17	15	37
19	19	21	34	38	10	12	23	29
21	23	16	39	31	14	7	33	19
23	28	12	44	27	19	2	42	9
25	30	9	46	23	21	1	46	3
27	30	9	45	24	20	0	44	4
29	25	13	42	28	16	2	36	11
30	23	14	39	30	14	5	32	16

Phases of the Moon.—New Moon, April 6th, 8.52 p.m.; First Quarter, April 14th, 10.55 p.m.; Full Moon, April 22nd, 7.30 p.m.; Last Quarter, April 28th, 12.17 p.m.

On April 15th the Sun will rise and set 13 degrees north of true east and true west respectively, and on the 6th and 19th the Moon will rise and set approximately at true east and true west respectively.

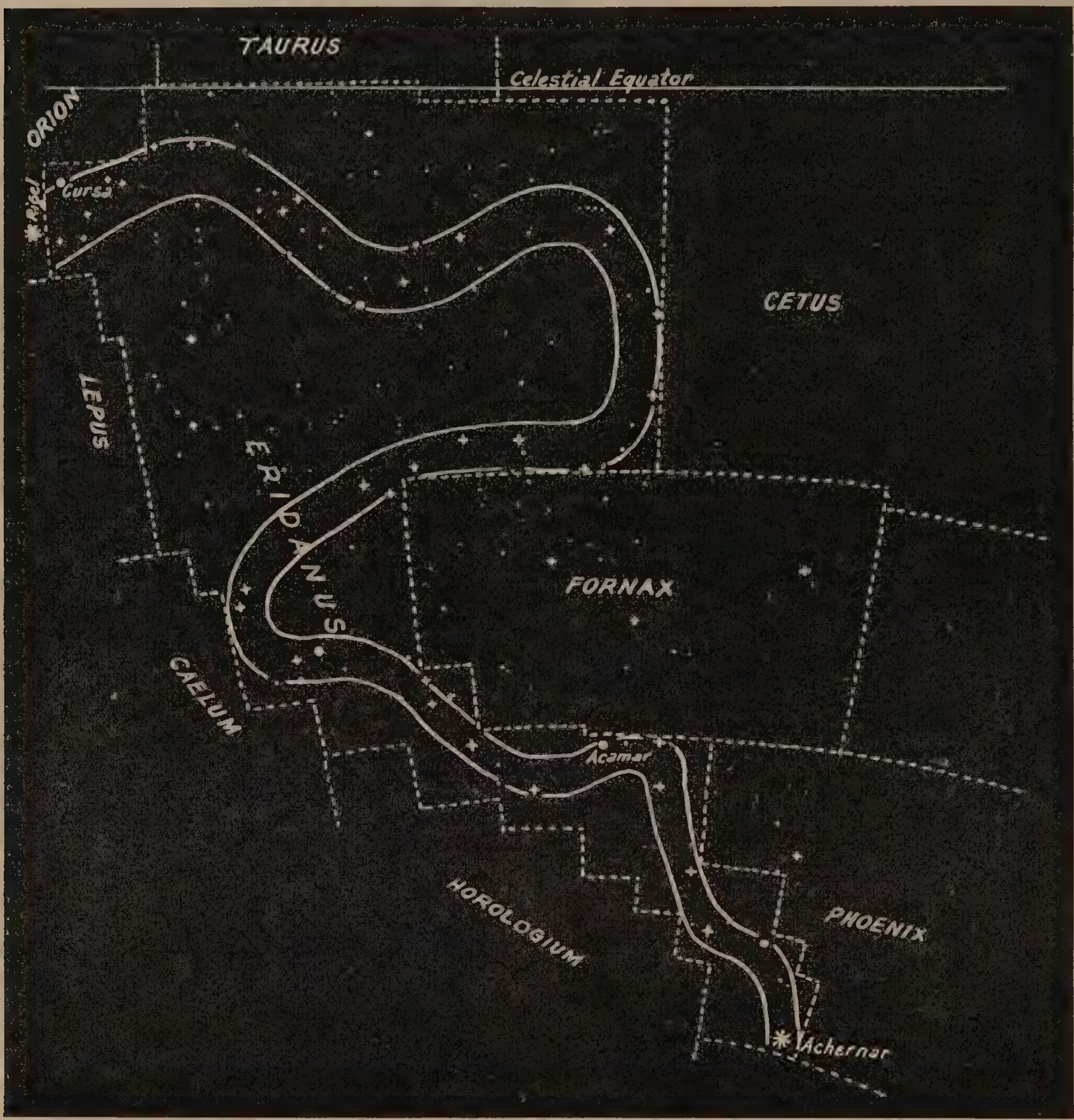
Mercury.—An evening object at the beginning of the month, when in the constellation of Aries it will set 45 minutes after the Sun. On the 5th it will be 19 degrees east of the Sun and on the 25th will be in line with the Sun, after which it will pass into the morning sky. By the end of the month, still in the constellation of Aries, it will rise 35 minutes before the Sun.

Venus.—At the beginning of the month, in the constellation of Aries, will set 1 hour 36 minutes after the Sun and on the 9th near midnight the Moon will pass 4 degrees to the north. By the end of April, in the constellation of Taurus, will set 2 hours 13 minutes after the Sun.

Mars.—Now too close to the Sun for observation.

Jupiter.—At the end of the month, in the constellation of Pisces, may be seen low in the west during morning twilight, when it will rise 2 hours 24 minutes before the Sun.

Saturn.—In the constellation of Virgo; at the beginning of the month will rise about sunset and is thus favourably placed for observation during the whole night. By the end of April it will rise during the afternoon daylight and will set between 3 a.m. and 4.15 a.m.



THE CONSTELLATIONS.

Phoenix.—A modern constellation adjoining Grus and Eridanus. It is not a very conspicuous group, containing only one star of second magnitude and two of third magnitude. The rest are of 4th or lower magnitude.

Sculptor.—Another inconspicuous modern group containing no star greater than 4th magnitude. It is important, however, for the fact that it contains the South Galactic Pole (the pole of the Milky Way).

Fornax (The Furnace).—Also a modern constellation, adjoining Sculptor, but does not contain any star greater than 4th magnitude.

Eridanus (The River Eridanus).—Eridanus is a Greek name for the River Po and this constellation is rather like a meandering river. It borders Orion, which straddles the equator on the north and straggles in a south-south-west direction to about declination 58 degrees, where it ends in the bright star Achernar, a well known navigation star and one used extensively in this country in survey work. The above diagram shows the name of several stars in the group.

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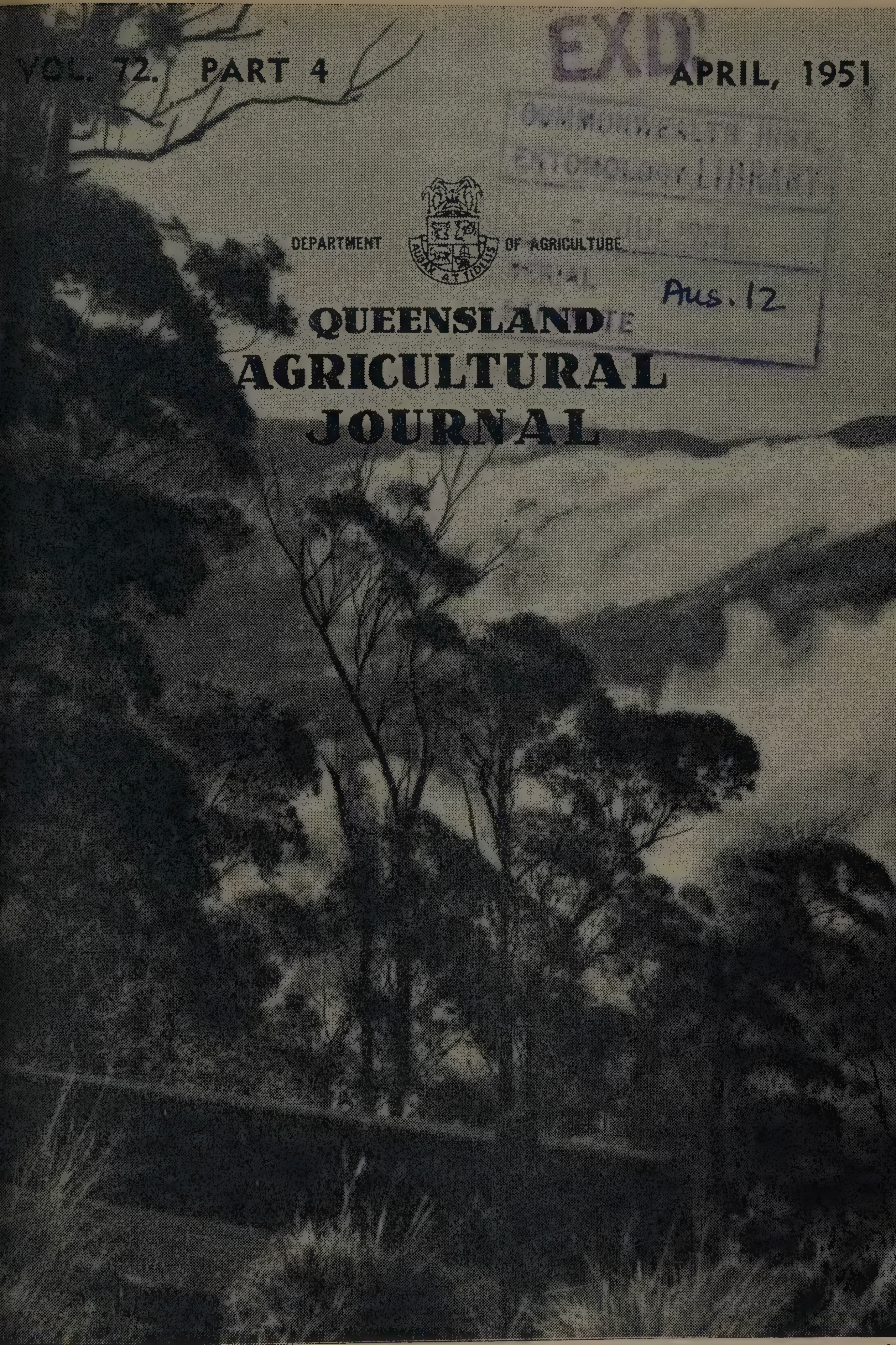
DEPARTMENT OF AGRICULTURE

QUEENSLAND AGRICULTURAL JOURNAL



Mists Rising on the McPherson R
South-Eastern Queensland.

LEADING FEATURES

Queensland's Resources

Agriculture in the Callide

Banana Growing

Feeding Dairy Calves

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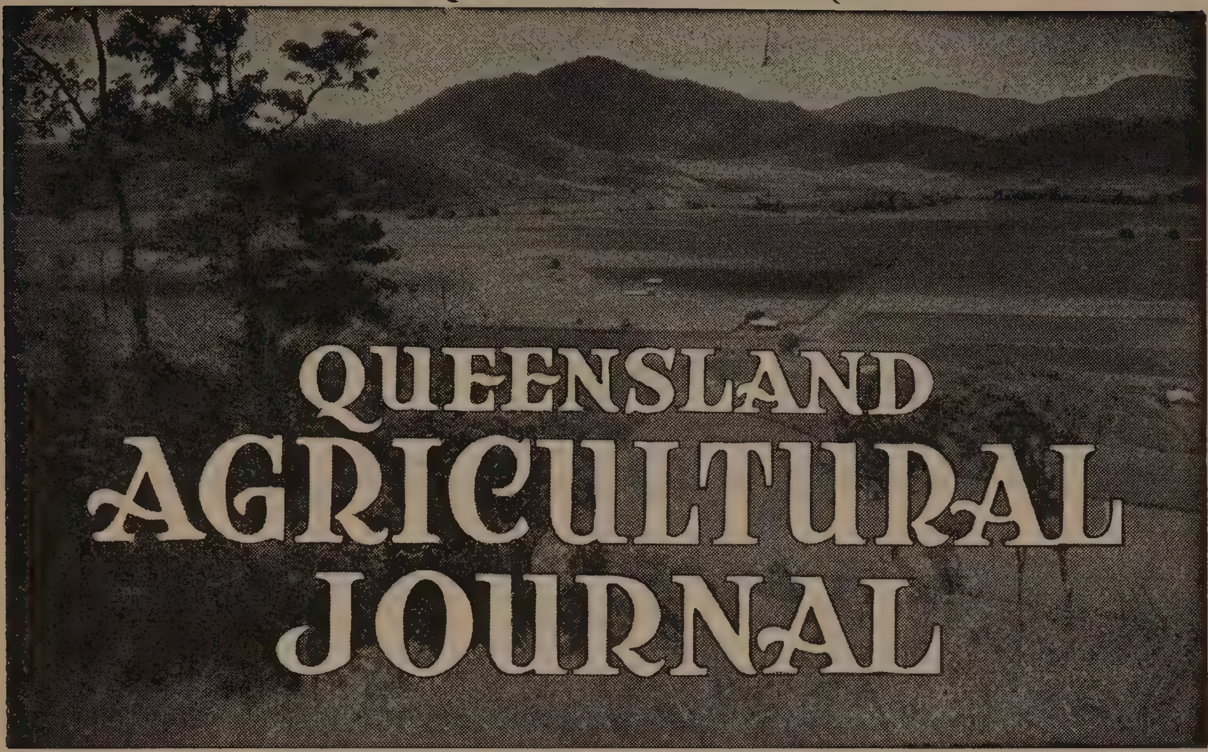


The Land and Water Resources of Queensland.*

ARTHUR F. BELL, Under Secretary.

AUSTRALIA follows the general pattern in that most of its inhabitants markedly over-estimate its soil and water resources, while most people overseas under-estimate them. In the sometimes strident opinion of local Chambers of Commerce it is a scenic land flowing with milk and honey; beyond our shores it is usually visualised as a desert with a very narrow coastal fringe of arable land.

Any accurate assessment of the natural resources of this country is made difficult by the combination of a vast area and a sparse population; yet a reasonable knowledge of such resources is necessary if rapid development is to proceed along sound lines, and most thinking people are agreed that some rapid development of this continent is necessary for our survival as an independent people.

Queensland occupies an area of 670,500 square miles, or nearly 430,000,000 acres; of this 360,000 square miles, or 54 per cent., lie within the tropics. The State contributes 22½ per cent. of the area of the Continent of Australia and, unlike the other large States, practically none of the land is unusable. Only 6 per cent., mainly in the upper part of Cape York Peninsula, is at present not occupied, but most of this is usable.

In contrast, the population is under 1,200,000 persons, or less than two to the square mile, and of these more than one-third live in the Greater Brisbane area. In the circumstances of this meagre population the development of the State has been amazingly great, but obviously there remains a very great deal yet to be done. In the next few minutes I shall endeavour to outline the extent and limitations of these resources which await development. And here I will apologise in advance for the quoting of a considerable amount of statistics, but it seems to be unavoidable.

* Lecture delivered to the Queensland Branch of the Royal Australian Chemical Institute, February, 1951.

Climate.

Climatically, Queensland experiences a wide variety of conditions, from the temperate tablelands of the south-east, to the great temperature range of the arid west, and the hot humid littoral of the northern tropics. Frost is a common occurrence over the greater part of the State, even on the tropical highlands, but the milder winter temperatures of even the most southerly coastal plains permit the continuous growth there of tropical crops, and ''out of season'' production of crops such as tomatoes and beans.

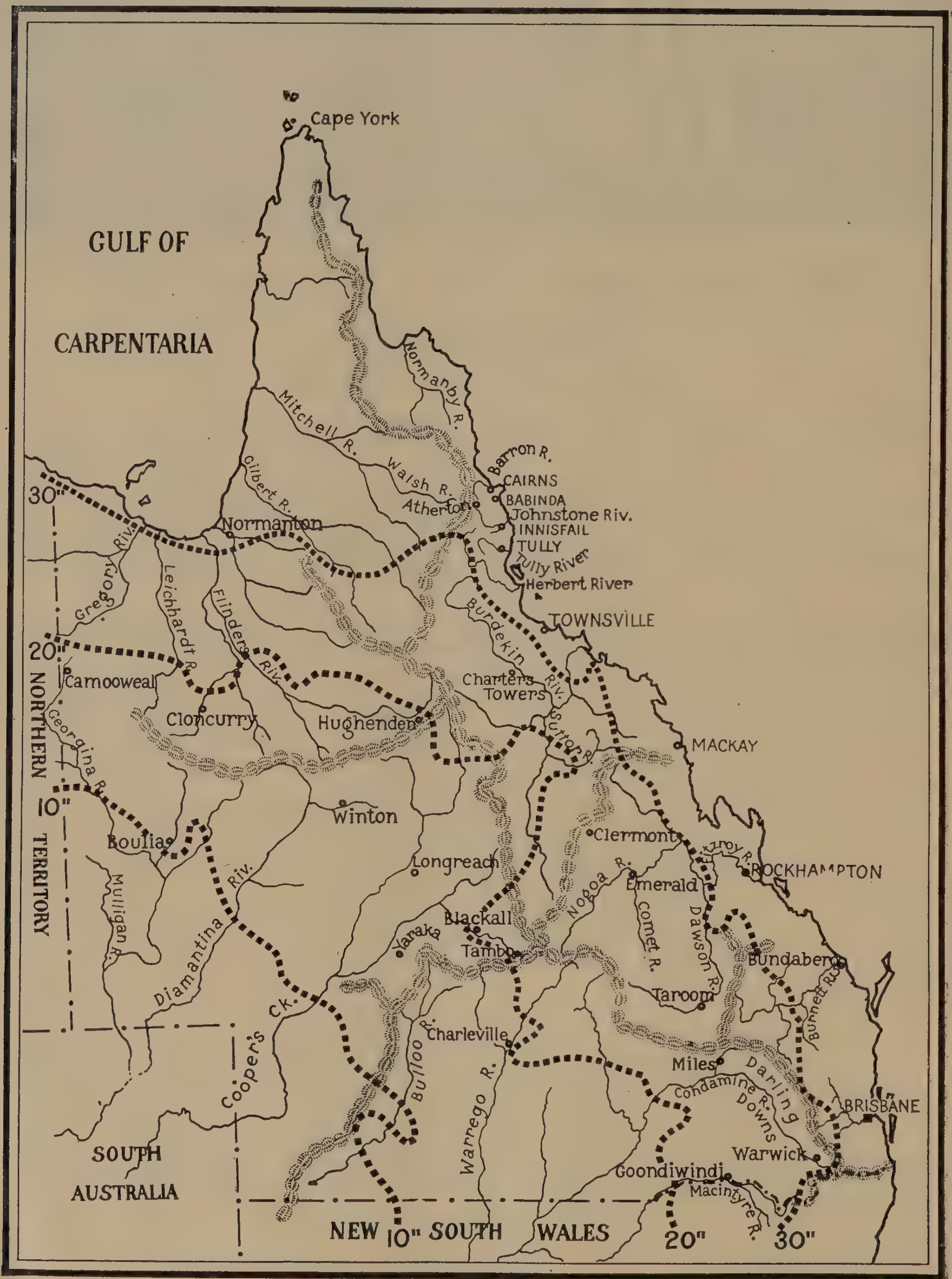


Plate 115.

Sketch Map of Queensland, Showing 10, 20 and 30 Inch Rainfall Lines.

The rainfall intensity and distribution are conditioned largely by the fact that mountain ranges are of only moderate height and lie close to the coast. The variation of rainfall is relatively greater than that of temperature and ranges from an average of five inches annually in the south-west to nearly 200 inches in the north-east, in the vicinity of the Bellenden-Ker range. Contrary to popular opinion Innisfail is not the wettest place in Queensland. Tully has an average rainfall of about 40 inches more than Innisfail and local Tully legend has it that if you can see the nearby Mount Mackay it is a sign of rain—and if you cannot see it, it is already raining. Actually the wettest recording station is at Deeral, just north of Babinda. In 1945 Deeral had eight yards of rain (of which 108 inches, or three yards, fell during the month of March), but this record was smashed last year when Tully registered 310.75 inches.

Unfortunately the State's rainfall is badly distributed throughout the year, even in the zones of high total rainfall. It is of the typical summer monsoonal type, much more than half normally falling during February-April, while the period July-December is often one of acute moisture deficiency.

During the monsoonal season flooding is common and the precipitation during short cyclonic disturbances may be astounding. During the cyclone of February 8-17 in 1949 the total rainfall for the 10 days was calculated to be 136,000,000 acre feet*. Stated in what are perhaps more realisable terms, this is more than 100 times the capacity of the Hume Reservoir (the largest in Australia); or nearly 4,000 times Brisbane's annual water consumption; or nearly 400 times the volume of water in Sydney Harbour.

However, we must not over-emphasise these heavy rainfalls. Only about 6 per cent. of Queensland receives an average annual rainfall of 50 inches or more. One-eighth of the State receives less than 10 inches and nearly half of it less than 20 inches; in these areas droughty conditions are a normal yearly occurrence and droughts of up to three years' duration may be expected periodically. One-third of the State receives between 20 and 30 inches and here partial drought conditions are a normal annual occurrence, with periodic severe droughts.

In assessing the value of the rainfall it must be borne in mind that the relatively high temperatures make water requirements greater. Evaporation rates are high, the evaporation potential being 55 inches at Warwick and 100 inches at Winton. Twenty inches of rain in Queensland is not nearly as good as 20 inches in Victoria.

River Systems.

Run-off from rainfall is carried away by four main river systems: The East Coast (of which the Fitzroy, Burdekin, Herbert, Tully, Johnstone, Barron, and Normanby are the main streams); Gulf of Carpentaria (Gregory, Leichhardt, Flinders, Gilbert, and Mitchell); Lake Eyre (Cooper, Diamantina, and Georgina); and the Murray-Darling (Macintyre, Condamine, Bulloo, and Warrego). It is of interest to note that there is much more of the Murray River watershed in Queensland than in Victoria; there is, in fact, more than 120,000 square miles in Queensland—which is nearly one and a-half times the size of the whole State of Victoria.

* An acre foot is the water required to cover an acre one foot deep and is a little more than a quarter of a million gallons.

Approximately 10 per cent. of Queensland's rainfall is discharged into the sea. The greatest discharge is that of the little-known Mitchell River which drains into the Gulf of Carpentaria; its average annual discharge is computed to be about 8,000,000 acre feet compared with the 5,800,000 acre feet of the Burdekin and between 4,000,000 and 5,000,000 acre feet for each of the Fitzroy, Herbert, Tully, and Normanby. For further comparison it may be noted that the average annual flow of the Murray is 10,000,000 acre feet and that of the Murrumbidgee, at Burrinjuck, is 950,000 acre feet.

Due to unfavourable rainfall distribution over the year only on the east coast are rivers perennial and even the mighty Burdekin and Fitzroy cease to run in the dry season.

An interesting exception is the Gregory River, which drains porous limstone country in the far north-west of Queensland and the adjacent Northern Territory. Like the Katherine, Daly, and Roper Rivers of the "Territory" it has a good dry season flow, about 60,000,000 gallons daily in this case; like these rivers also the water is charged with lime, the pH being somewhat above 7. Since the soils of the area are in the vicinity of neutrality, irrigation with this slightly alkaline water may develop some problems, as has been the case in the Katherine, where zinc and iron deficiencies soon become evident.

Soils and Vegetation.

The soils and vegetation of Queensland exhibit very great diversity. This must be expected in an area of 670,000 square miles, extending over 19 degrees of latitude, with annual rainfall ranging from five to 200 inches, elevations from sea level to 5,000 feet, a high temperature range, and geological strata from Pre-Cambrian to comparatively recent basaltic flows. It follows that in a short survey of this type only the major divisions can be considered, and they only briefly.

1. The eastern fringe between the coastal mountains and the sea, and including Cape York Peninsula, receives an annual rainfall of 40 inches or more. Throughout this zone are found discontinuous areas of comparatively rich alluvial soils associated with the coastal streams and on which intensive agriculture is now practised; there are also a number of isolated areas of red volcanic loam. On these soils and on much of the eastern slopes of the coast range and over very considerable areas between Ingham and Cairns there were, and still are, dense rain forests. With these exceptions the soils of the east coast are podzolised types, with shallow "A" horizons, acid in reaction, of relatively low fertility, and particularly deficient in lime and phosphates. In some sections in the northern part of the State, within the region of podzols, solonized soils occur as a result of incomplete leaching due to lighter rainfall, high run-off, and high evaporation.

The podzolised types carry woodland savannah and are utilised for cattle raising. The original grasses were mainly kangaroo grass, and blue grasses in the drier areas, but these have been largely displaced by black spear grass, particularly where annual burning or over-stocking has occurred. In the more tropical parts Townsville lucerne, which was fortuitously introduced from South America, is now spreading fairly rapidly. Presumably this is due to the evolution of new strains and this factor may well prove of great importance to the pastoral industry. In the better rainfall areas are large tracts of relatively deep

and medium textured podzols which carry heavier pasture growth and if topdressed with lime and phosphate become well suited for dairying; in the southern pastures paspalum gives good results, particularly when combined with white clover.

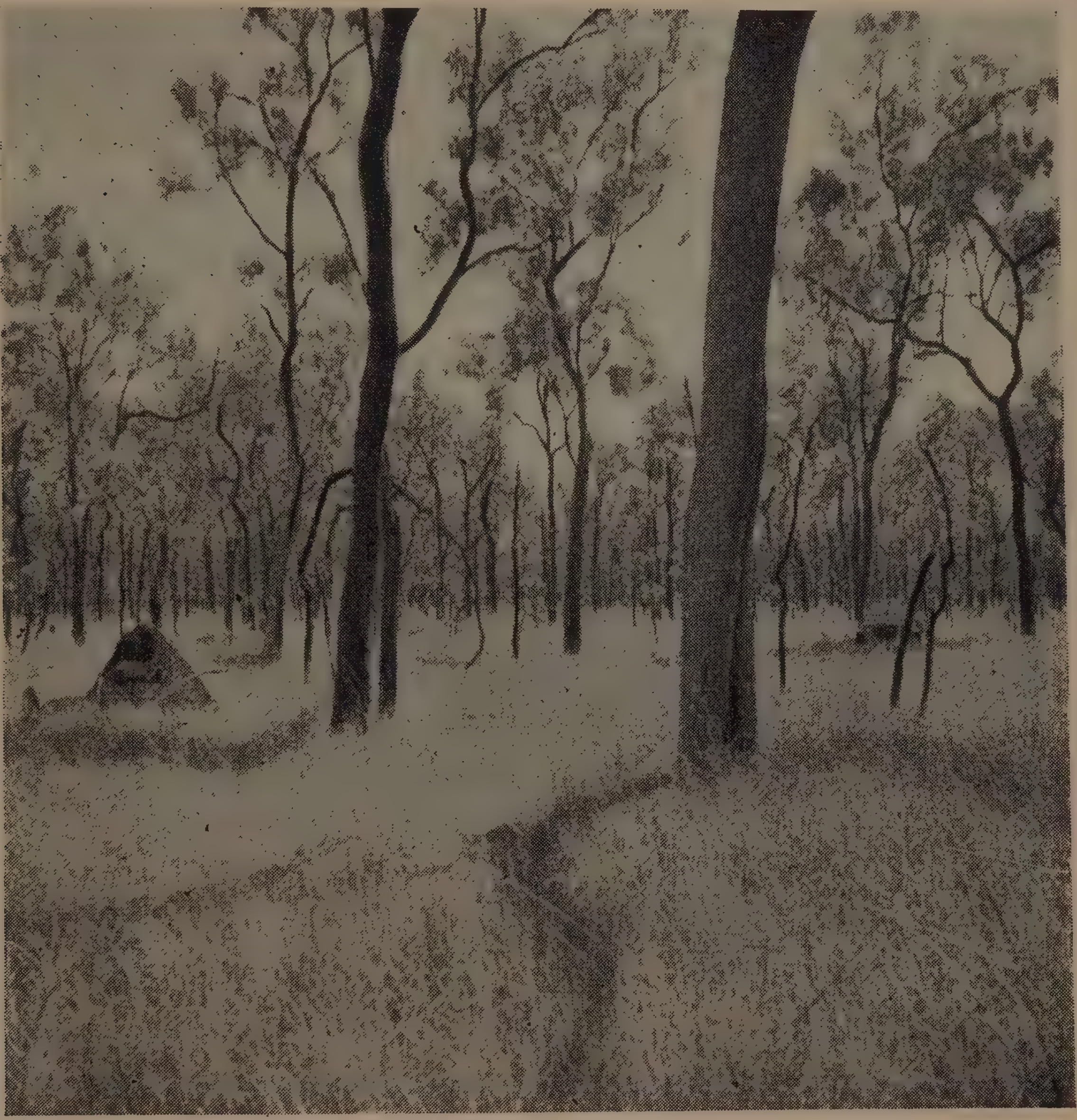


Plate 116.

Woodland Savannah of the Gulf Country.—Note the anthill in the left centre.

2. Several extensive areas of red loam soils, mostly volcanic in origin, occur on the coast and hinterland. These are (*a*) Redlands district—devoted to fruit and vegetable production; (*b*) Blackall Range—fruit growing and dairying; (*c*) South Burnett—maize, peanuts, and dairying; (d) Highlands of the Central and Upper Burnett—dairying; (*e*) and (*f*) Bundaberg-Isis and Johnstone—sugar cane production; and (*g*) and (*h*) Atherton Tableland and Eungella—maize and dairying. These soils are deep, with good physical condition and reasonably good fertility, although usually lacking potash. Paspalum and kikuyu are now the dominant grasses in the higher rainfall areas and under good management provide excellent pastures, particularly when combined with white clover; Rhodes grass has been extensively sown on the Burnett loams.

3. In the hinterland beyond the coast ranges, mainly in the 25 to 30 inch rainfall zone, is a belt of heavy black, grey, and brown soils of generally high fertility. This belt extends in from New South Wales and runs discontinuously slightly west of north, centred on the towns of Goondiwindi, Miles, Taroom, Emerald, and Clermont, to the Suttor River. Then there is a major break between the Suttor and the Flinders Rivers, whence the belt continues with two branches, one running north towards and slightly to the west of the Atherton Tableland, and the other running north-west to the Gulf of Carpentaria.

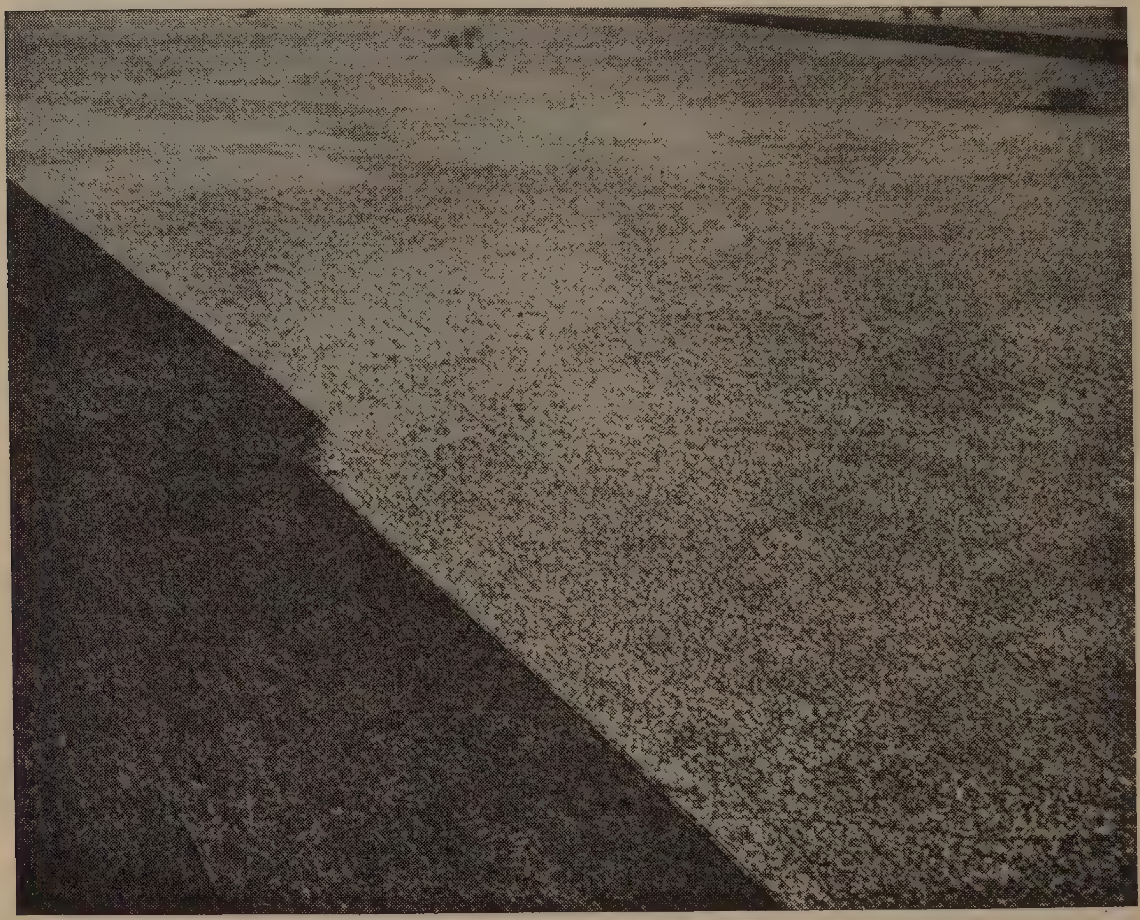


Plate 117.

Aerial View of Ploughing on the Queensland-British Food Corporation's Property at Peak Downs, between Emerald and Clermont.

The black soils are usually of basaltic origin and the greys and browns are derived from calcareous sandstone and alluvia of mixed basaltic and standstone origin. The best of these soils are the black earths of the Darling Downs, where the more favourable rainfall distribution conduces to agriculture of a high order; they are characterised by extensive areas of open rolling downs of deep friable self-mulching soil, moderately high in organic matter and well supplied with mineral plant foods. A further large area of black basaltic soils occurs on the central highlands, around Emerald, where the Queensland-British Food Corporation is growing grain sorghum on a large scale. Originally the more northerly of these black soils were dominated by Queensland blue grass, but continued grazing, associated to some extent with drought, has resulted in considerable replacement by Mitchell and white spear grasses; annual grasses and herbage plants are an important component of these pastures. Under the better rainfall distribution on the Darling Downs some southern species such as wallaby and spring

grasses are as important as the blue grasses; the extension of naturalised burr medic in more southerly parts of this zone is of particular importance.

The grey (most people would call them black) and brown soils in the central and southern parts of the belt originally supported a heavy growth of brigalow and other mixed timbers; they later became heavily infested with prickly pear, which was subsequently eradicated in spectacular manner by *Cactoblastis cactorum.* After clearing, a considerable proportion of these soils nearer the coast has been seeded to Rhodes grass to produce a good pasture; they have been used for agriculture to a less extent. It seems probable, however, that

Plate 118.

View of Darling Downs Wheat Country.

they will eventually be extensively cultivated for the production of summer crops for direct animal production; they are less well supplied with phosphates and organic matter than the black soils but are still highly productive under suitable rainfall conditions.

4. In the 10 to 20 inch rainfall zone, a belt of red soils derived from ancient laterites, broken by patches of grey pedocals, extends northward. South of Yaraka these lateritic derivatives carry mostly mulga, with or without other tree species. No one grass is dominant and for pasturage the sheep depend mainly on a great diversity of annual and perennial grasses and herbage, together with windfall leaves from selected trees. The mulga itself is a very important fodder constituent and is known as "top" feed; in times of scarcity of grass and herbage these trees are often lopped or knocked down to provide maintenance fodder for sheep.

5. Beyond the Suttor River, and extending north towards Charters Towers and into the base of the Peninsula, is another belt of lateritic derivatives, given over to cattle raising and carrying medium forest cover. On its northern end this, and residual red earths, are used for tobacco production. The pasturage is mostly coarse and tufted, and spinifex, spear grasses, and native sorghums are the main pasture components.

6. North-west of a line from Tambo to Blackall are large expanses of grey and grey-brown pedocals mostly derived from calcareous sandstone. Some of these are residual and others are alluvials on old flood plains of the rivers. The pedocals are dominated by Mitchell grass and are characteristically treeless rolling downs extending as far north as the Flinders River; on the northern plains Flinders and button grasses occur in heavy stands. They also support a variety of herbage plants which are particularly valuable as supplements to the carbohydrate-rich, but protein-deficient, Mitchell grass.

7. Finally there is a unique zone, aggregating some ten million acres, consisting of the flood plains of the Diamantina, Mulligan, Georgina, Cooper, and Bulloo. The soils of these flood plains are heavy grey clays of remarkable fertility (available phosphate is over 300 p.p.m.) which produce a heavy body of a considerable variety of annual grasses and herbage after flooding. Hereabouts the country drops less than one foot per mile and the slow-moving streams cease to be sharply delineated and spread out over the plain in a labyrinth of shallow anastomosing channels. These streams rise in zones of 15 to 25 inch monsoonal rainfall and periodically flood. As the floods recede the grass and herbage spring up and provide grazing of high nutritive value; unfortunately the floods are very variable in size and unreliable as to frequency, with the result that it has never been possible to have available sufficient cattle to graze the fodder produced by even a moderate flood.

Surrounding the flood plains are desert sandhills and sand plains, desert loams, stony downs, and lateritic top rock. Rainfall is five to seven inches and the carrying capacity of the channel country is in a large measure determined by the carrying capacity of this higher country when the channels are not available for grazing—say December to June.

So much for the distribution of main soil groups. In passing it may be said that experienced observers believe that about 5 per cent. of Queensland is covered by stones.

Agricultural Use.

Up to the present, extensive agricultural development has been confined to the black and grey soils of the Darling Downs, alluvial soils, and the red volcanics of the coast and hinterlands. Generally speaking, these are deep soils of fertility considerably greater than the average of Australian agricultural soils. Mostly they are well supplied with phosphates and Queensland is responsible for only 1.25 per cent. of Australia's phosphate consumption. By contrast, such relatively few tests as have been made in the pastoral areas indicate that apart from the black soil belt and the flood plains of the inland rivers these soils are deficient in phosphate. Just what can be done to remedy this is one of the problems of the future; obviously topdressing on a 1,000 square mile cattle property cannot be lightly contemplated.

Potash is deficient in many of the coastal agricultural soils, particularly the red volcanics, and more than half Australia's usage of this fertilizer is applied to sugar cane, pineapples, and bananas in Queensland.

As must be expected, nitrogen rapidly becomes deficient in tropical and sub-tropical soils under cultivation, and the growing of leguminous cover crops and the application of nitrogenous fertilizers are widely practised. As in the case of potash, Queensland uses more nitrogenous fertilizer than the rest of Australia. Unfortunately for the pastoral

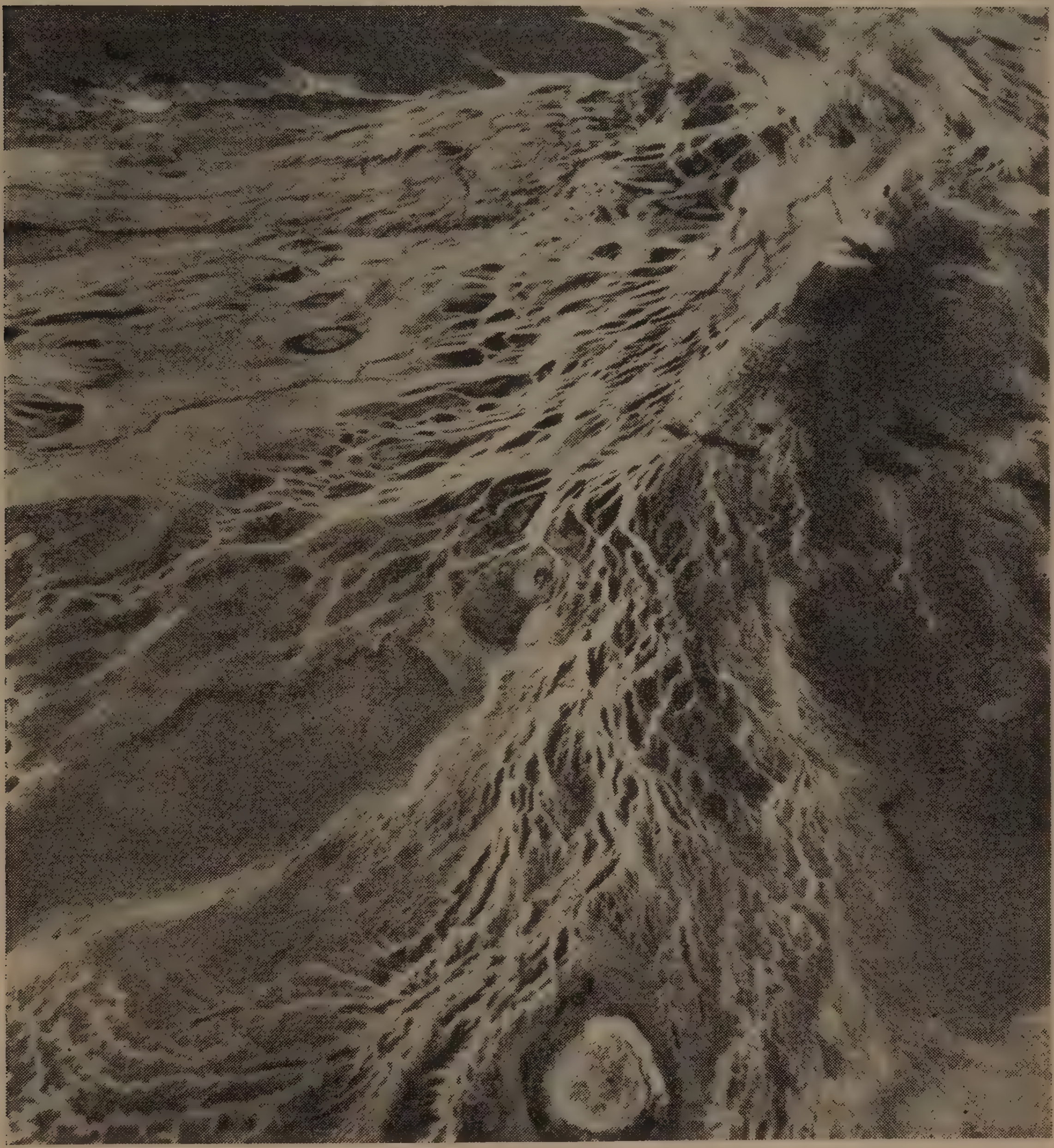


Plate 119.

Channel Country of Cooper's Creek.—Aerial photograph taken at an elevation of 17,000 feet.

industries, we have not yet found or developed a suitable legume for incorporation in pastures other than in the wet tropical belt. There is nothing in any way comparable to the subterranean clover of the southern States and Queensland pastures are consequently generally low in protein.

Nitrogen is undoubtedly the big and increasing need of both pastoral and agricultural industries and the development of pasture legumes on the one hand, and the domestic manufacture of synthetic nitrogen on the other, become ever more urgent.

Minor element deficiencies are not as pronounced as in the less acid and/or lighter textured soils of the south; however, they are becoming

increasingly known and copper deficiency causing steely wool in sheep, phosphate deficiency causing chalky bones in cattle, and zinc and boron deficiencies in orchards may be cited.

Soil erosion is now causing serious concern. Wind erosion is relatively unimportant but water erosion has increased rapidly in incidence during the past few years, particularly as a result of the increased areas sown to wheat.

The severe summer storms characteristic of the subtropics and tropics, when rainfalls at the rate of two inches per hour are common, make erosion control more difficult. This is particularly so when, as in the case of winter-sown crops such as wheat, moisture is conserved by bare fallow during the summer; the soil is thus left without a protective cover during the period of greatest erosion hazard. Investigational work over the past few years has developed suitable mechanical and cropping practices necessary to effect soil conservation in most areas, but the problem bristles with legislative and administrative difficulties. These are greatly accentuated by the great size, sparse population, and relatively small national income of Queensland; obviously this State cannot render the assistance, nor undertake the intensive control, which is a feature of United States soil conservation practice. Unfortunately, too, Australians have developed in an excessive degree the propensity to "leave it to the Government."

Closely associated with soil conservation and control of river bank erosion is the preservation and growth of timber. Ringbarking and clearing have too often been carried out on a face and insufficient attention paid to the retention of strips of timbered country and the maintenance of stream banks. In very many cases slopes which should have been retained for timber production have been cleared and are now being eroded at an alarming rate.

Considering its size Queensland's timber resources, particularly in softwoods, are limited. About three and a-half million acres are now permanent forest reserves and another three million acres are temporary reserves. Some 35,000 acres have been replanted to forests and nearly half a million acres treated for natural regeneration.

Irrigation.

In a country of poorly distributed and generally deficient rainfall, the irrigation potential naturally assumes great importance, and this is very true of Queensland. As a whole this State is not well endowed in respect of its irrigation potential and there is thus a correspondingly greater necessity for development to proceed on soundly planned permanent lines.

The absence of snow-capped mountains means that there is no steady spring and early-summer stream flow such as is experienced in the vicinity of the Australian Alps. This country is geologically old and the mountain ranges are weathered, so that there are relatively few deep enclosed gorges such as are necessary for the economic storage of large volumes of water; this is particularly true of the rivers which flow inland. In the zones of higher rainfall in Queensland the mountains are close to the sea, so the courses of the coastal rivers are often short and steep, which also militates against the economic storage of large volumes; if a stream falls 30 or 40 feet in a mile it is obvious that a dam of reasonable height will not back up the water very far. Finally, the poor distribution of the rainfall means that the run of the stream is small or nothing for most of the year and reservoir storage must supply practically all the water.

Rainfall is absorbed into the ground, is evaporated into the atmosphere from plants or wet surfaces, or flows away in streams. Only that part which finds its way into streams can be stored in reservoirs for irrigation, and this proportion of the rainfall is very much less than is commonly supposed. In fact, in the 20 to 30-inch rainfall belt (which is one-third of Queensland) the amount which runs off in streams is less than the equivalent of one inch. The proportion of run-off rises rapidly as the rainfall increases; in the Condamine (Darling Downs) river basin, with an average rainfall of 27 inches, the run-off is slightly less than 2 per cent.; on the Tully, with an average rainfall of 102 inches, the run-off is 62 per cent.

There are probably more wrong ideas on the availability of irrigation water than on most other subjects. The sight of a very few square miles of shallow flood waters moves most people to ecstatic contemplation of vast irrigation schemes all over the country; they lose sight of the fact that this water is usually the run-off from thousands of square miles and that probably there is not enough water to permit adequate irrigation of even the area inundated.

Obviously not all stream water can be held for irrigation: the riparian rights of landholders downstream must be preserved; many streams cannot be dammed; it is rarely that reservoirs can be built large enough to contain the whole flow in the wet season; in the wetter areas it would not usually be economic to incur large costs for supplementary irrigation; and so on.

Water impounded in reservoirs suffers further losses through evaporation and seepage from the dams, distribution channels, and field ditches before it reaches the crops growing in the fields. General experience is that rarely does much more than one-third of the impounded water reach the fields.

Taking all these factors into consideration, it has been computed that the maximum area which could possibly (not economically) be irrigated in Queensland is about two million acres, or about one-half of 1 per cent. of the total area of the State.

The increased production which accompanies irrigation is very great, even in areas of fair rainfall. In his report for the year 1949-50, the Commissioner for Irrigation in Queensland stated that while the irrigated area of 98,500 acres comprised only 5 per cent. of the area under crop, it contributed over 30 per cent. of the total crop value.

The recently reconstituted Irrigation Commission is now conducting intensive surveys of irrigation potential. Major schemes now being investigated are (passing from north to south):—

1. Walsh and Barron Rivers to serve the tobacco areas of Mareeba-Dimbulah.
2. Burdekin River (this is by far the largest scheme).
3. Nogoa and Comet Rivers of the Fitzroy basin.
4. Dawson River, extending the present Theodore scheme.
5. Dumaresq, a joint scheme with New South Wales.

It is unfortunate that water is not freely available to serve Queensland's main agricultural area—the Darling Downs; however, it is very doubtful whether sufficient surface water could be stored on the Condamine River to irrigate 10,000 acres.

The examination of irrigation potential has disclosed that more than half the river flow in Queensland is to be found in streams which enter the sea from the shores of Cape York Peninsula. Since the watersheds of these streams occupy only about one-eighth the area of Queensland it is apparent that as far as water is concerned this is the best endowed section of the State. At the same time it is true that the soils are generally of low fertility and very few sites for even moderately sized reservoirs are likely to be found. Small reservoirs are generally costly per unit volume of water impounded, and flood control is difficult under such conditions. Nevertheless, in spite of these obvious and serious drawbacks the fact remains that the water is there and some day this lonely, undeveloped, and strategically important area may well carry a large population based on irrigation.

Plate 120.

An Irrigated Tobacco Crop at Clare, Burdekin River.

So far, any detailed discussion has dealt only with the use of surface water for irrigation. When the land surface is underlain by permeable and porous layers such as sand or gravel, a portion of the absorbed rainfall percolates down to these layers, from which it may be pumped through wells and bores. If the water-bearing layer, or aquifer, is of considerable volume, and sufficiently porous, water may be drawn off at adequate speed for irrigation.

Provided the aquifers are sufficiently near the ground surface for economic pumping, such a source of supply is very convenient, and at the present time more than half the irrigated area in Queensland is watered from underground supplies. Notable areas are the Burdekin (30,000 acres), Lockyer Valley (12,500 acres) and Bundaberg (10,000 acres). Underground water has the advantage that reservoir and distribution channel losses are eliminated; it has the disadvantage that it is much more mineralised than surface water and the common minerals sodium and magnesium have a marked deleterious effect on heavy soils.

Being derived from wells with individual pumps, underground water supplies are not dependent upon the prior construction of large storage and distribution facilities, and can thus be developed rapidly. In the case of the rich Lockyer Valley, irrigation from wells rapidly followed the reticulation of cheap electric power. In the Burdekin Delta, over an area less than one-half that of Greater Brisbane, it has been computed that the farmers' pumps have an aggregate pumping capacity of 900,000,000 gallons per day, or more than 30 times Brisbane's daily water consumption.

The full extent to which supplies of underground water are available for irrigation is not known, and as personnel and equipment became available for boring it is most important that surveys of underground water be energetically pursued. Certainly the area irrigated from underground water can and will be expanded greatly.

While on the subject of irrigation, perhaps it might be expected that a word should be said on Australia's most publicised irrigation proposals, the so-called "Bradfield Scheme." This was originally submitted by the late Dr. J. J. C. Bradfield to the Queensland Government as a scheme worthy of investigation; it has since been adopted by enthusiastic authors and orators who have carried it into the realms of engineering and social phantasy.

Briefly, the basic proposal is that the waters of the coastal streams Tully, Herbert, and Upper Burdekin should be diverted inland by dam and tunnel and eventually delivered into the upper reaches of Cooper's Creek near Hughenden. It is generally proposed that the water would then be used for the irrigation of the inland and also to keep Lake Eyre filled with water, the latter then being expected to exercise a profound influence on the climate of Central Australia and to substitute humidity for aridity.

Bradfield had no detailed first-hand knowledge of the country, and the considerable amount of hydrological and engineering data since accumulated was not available to him. It may now be stated that the flow of these rivers is only about one-third that calculated by Bradfield; that the coolamons of the Flinders would not make large-scale reservoirs; and that the scheme is, in fact, physically impossible because the highest possible dam at Hell's Gate would not suffice to raise the water high enough to spill it into the inland river system.

The diversion of this coastal water would, of course, eliminate hydro-electric projects (such as now being developed on the Tully) and seriously interfere with power development and irrigation on the Burdekin. As propounded, the scheme necessitated the running of water hundreds of miles before use, so water wastage by seepage would have been stupendous. The ratio of irrigated land to total water would thus have been very low and the costs of irrigation correspondingly high.

As to the influence of a water-holding Lake Eyre on climate, there is no reason to believe that it would be any different from that of other lakes and seas in flat country in these latitudes. There is no apparent influence on climate and rainfall exerted by the Dead Sea, the Red Sea, or even by the combined effects of the Mediterranean and vast irrigated areas in Egypt.

Artesian Water.

No discussion of Queensland's water resources would be complete without reference to artesian water.

There are several artesian basins in Australia, but by far the largest (and incidentally the largest in the world) is the Great Artesian Basin underlying an area of 550,000 square miles in Queensland, New South Wales, South Australia, and the Northern Territory. Some 350,000 square miles, or considerably more than half, lies within Queensland and embraces the territory lying inland of the Great Dividing Range, with the exception of an area of highlands between Boulia, Cloncurry, and the Northern Territory border.

Plate 121.

An Artesian Bore Yielding 580,000 Gallons Per Day After Flowing for Fifty Years.—Note the bore drain running away into the middle background.

Within the artesian basin, water is held under pressure at considerable depths between two impervious layers of rock. When this water-bearing layer is pierced by boring the water surges upward. In many cases the pressure is sufficient to force the water above ground level and these are known as flowing, or artesian, bores. In others the pressure is insufficient to force the water to the surface and pumping is necessary; these in turn are known as sub-artesian bores, and an artesian bore may become sub-artesian when local reduction of pressure causes it to cease flowing.

Several theories as to the origin of this artesian water have been advanced, but the now accepted explanation is that rain water is absorbed through elevated sandstone outcrops, which in this case lie on the eastern boundaries of the basin. The absorbed water then passes very slowly downwards and westwards through the aquifers, the pressure increasing as the depth below the intake beds increases.

The first deep bore in Queensland was put down near Blackall in 1885 and is still flowing. Since then some 2,200 artesian bores have been sunk to an average depth of about 1,550 feet, the deepest being just over 7,000 feet.

In addition to artesian bores, over 5,000 sub-artesian bores have been put down within the basin.

The artesian beds are in a state of tension and it is characteristic of artesian bores that the initial flow is the maximum and declines as the local pressure is reduced by the escape of water at a rate greater than it is replaced. Of the 2,200 artesian bores put down about 700 have since ceased to flow and must now be pumped.

The method of using artesian water on pastoral holdings is very wasteful of water; the discharge from the bore is delivered into excavated "bore drains" through which it flows as far as the rates of delivery, seepage, and evaporation permit; in some cases the length of bore drain may total a hundred miles. There are, in all, about 20,000 miles of bore drain in Queensland. Losses from seepage and evaporation in this arid area are naturally enormous, but on the other hand this method of reticulation is very cheap, the only continuing expense being periodic clearing of the drains. One good artesian bore will serve many square miles of country, whereas pump bores must be set much closer together.

It will be appreciated that at first the increasing number of bores increased the aggregate rate of flow, but eventually the decreasing flow of individual bores more than compensated for new bores and the aggregate flow declined. The peak flow was estimated at 355 million gallons daily in 1914 but this has now declined to somewhat more than 200 million gallons per day. The Artesian Basin Committee estimated in 1943 that the total flow to that date had been 5,200,000 million gallons, or enough to fill Sydney Harbour 55 times. At the same time it should be borne in mind that this is equivalent to less than one inch of water over the Queensland part of the basin.

Since the majority of the 20,000,000 sheep normally depastured in Queensland obtain their drinking water from the artesian basin, the permanency of this supply, and the causation of diminished bore flow, were obviously matters of national concern, and in 1939 the Queensland Government appointed a Committee to investigate the problem. This Committee has issued an interim report which allays some fears regarding the use of this great natural resource.

Briefly the position appears to be: The steady absorption of rain water through the intake beds continues; these intake beds are estimated to be about 30,000 square miles in area; they lie in the 25-inch rainfall belt and the current annual discharge from bores is equal to only one-fifth of an inch of water spread over the intake beds. Thus it is considered that the reduced flow of bores is not due to a reduced intake volume but to a diminution of the elastic pressure in the vicinity of each bore. In support of this conclusion may be noted the fact that capping a bore, or restricting its flow, will enable pressure to be built up again. Reduction of flow in winter, when less water is required, would thus bring about some build-up of pressure to give a greater flow in summer, when evaporation is high.

The final report of the Committee should be completed in the near future and this will no doubt contain observations on the necessity or otherwise for regulation of flow and stricter control of boring. One

important factor is that the generally low-carrying capacity of the country makes pipe or sealed drain reticulation of the bore water an economic impracticability.

The temperature of artesian water increases with the depth from which it is derived and water from the deep bores approximates boiling point. It also has a relatively high mineral content and, generally, is useless for permanent irrigation. As a point of interest it may be noted that even if the water were suitable for irrigation the present total delivery of bore water would be sufficient to irrigate only about 80,000 acres.

The concentration of bore water by evaporation in the drains produces problems such as fluorosis. A fluorine content of a couple of grains per gallon at the bore head may at the end of the drain have increased to eight or ten grains, at which concentration it has a very deleterious effect on developing bone structure and teeth of sheep. Sheep may die of starvation owing to the degeneration of their teeth and consequent reduced efficiency in feeding when feed begins to get scarce.

There are no permanent streams in the Great Artesian Basin and the collection and storage of surface water presents very considerable difficulties in that flat country of low and uncertain rainfall and high evaporation. It is no exaggeration to say that the sheep and wool industry of Queensland depends for its existence upon the underground waters of this artesian basin.

Land Use.

The land policy of Queensland has for many years been the retention of ownership by the Crown and leasing under varying conditions for fixed terms of years, or, in the case of agricultural land, under perpetual lease. Freehold, which is mainly confined to the agricultural areas, comprises about 6·5 per cent. of the total compared with 33·5 per cent. in New South Wales and 57·8 per cent. in Victoria.

Only 2,000,000 acres, or less than one half of 1 per cent. of the land in the State, is cropped annually. Excluding this proportionately small area the State is divided into three sections:—(1) the outer cattle area extending inwards from the east and north coasts to the 20-inch isohyet; (2) the sheep area extending inland from the 20-inch isohyet to the channel country of the south-west and the tableland west of Cloncurry; and (3) the inner cattle area embracing the channel and associated country and the north-west tablelands.

Approximately two-thirds of the State is given over to cattle raising and one-third to sheep. On this area are normally depastured some five million beef cattle (or more than half the beef cattle of Australia) and around 20 million sheep. There are, in addition, about one and one-third million dairy cattle but these are concentrated in, or on the fringe of, the agricultural areas. Virtually all the beef cattle and sheep derive their sustenance from natural pastures while a large proportion of the dairy cattle feed almost exclusively on native or introduced grasses. Thus grass is by far the most important crop in Queensland, supporting as it does the beef, mutton, and wool industries and a large part of the dairy industry.

Due to the rainfall distribution, and problems of transport, the cattle industry is largely nomadic. From the vast breeding grounds of the Peninsula and Gulf areas cattle are droved south-eastwards to the coast, and to some extent south to the channel country, and there fattened before despatch to the meatworks. The greatest concentration of beef cattle is in the hinterland of Rockhampton, where both breeding and fattening are conducted.

Overall, the cattle country carries an average of about 12 beasts to the square mile, ranging from a beast to 10 acres in the Burnett, to three or four to the mile in the low rainfall areas or on poor country. The carrying capacity of the natural pastures could be markedly increased in most seasons by better subdivision, ringbarking, the provision of additional permanent water points, and the better management which would be possible if more fencing and more labour were available.

Such improvements would, however, carry the cattle industry forward only a certain way and in this connection it should be noted that in spite of the great property improvement over the past half century there has been no permanent increase in the number of beef cattle. It would appear that the basic limiting factor is the shortage of nutritious feed which in the normal dry season each year seriously reduces the condition of the cattle, and which in the recurrent drought years results in heavy mortality. As a result of the 1946 drought beef cattle numbers dropped by more than half a million between 1945 and 1948; due to good seasons, numbers are now building up again but under present production conditions we may expect that another drought will in a few years reduce them again to the 1948 level.

In addition to the usual items of property and management improvement mentioned above, the factors limiting permanent increase in beef cattle numbers and production will only be removed by:—

(*a*) The conservation of natural grasses or cultivated crops in order to feed stock, and maintain breeding stock, in times of fodder shortage.

Included within the outer cattle area are some 40 million acres of fertile heavy soil, receiving more than 20 inches of rain, which would produce summer crops. There are many practical and economic problems to be solved before fodder production and conservation can be carried out on a large scale and, at least up to the present, beef prices have precluded much development in this direction.

(*b*) The development of pasture legumes which will grow satisfactorily under the harsh conditions.

The natural grasses grow very vigorously during the wet season but soon dry and lose their nutritive value; the incorporation of a legume would serve to raise the protein status. In spite of a considerable amount of work by C.S.I.R.O. and the Department of Agriculture and Stock this problem remains unsolved.

(*c*) A very considerable development of rail transport is necessary to ensure the effective removal of stock in times of drought, or to facilitate the marketing of young stock, aged cows, and any fat cattle from the outer areas where, in most cases, fodder production will remain impracticable. The development of road transport would also facilitate the removal of fat cattle but otherwise such transport is not promising with current values.

It is unlikely that any form of fodder cultivation could be undertaken in the sheep areas with the exception of the south-eastern corner of the zone. In Queensland latitudes a 20-inch rainfall must be regarded as a minimum for any form of sustained crop production. Problems which claim attention in the sheep zone are a search for new pasture plants, methods for the harvesting and regeneration of mulga (top feed) and pasture management.

Excluding the Darling Downs the dairy industry is conducted largely on a pastoral basis, with consequent low and highly variable seasonal yields. Rising prices of land, and rising value of dairy products will no doubt gradually bring about "dairy farming" as distinct from mere "dairying."

It comes as a surprise to most Queenslanders to learn that there is twice as much land under crop in South Australia as there is in Queensland; this is not due solely to wheat, as the area under crops other than wheat is also greater than in Queensland. This relatively small acreage in Queensland is no doubt due in part to cheaper land which permits extensive rather than intensive dairying and sheep raising. At the same time, due to the cultivation of high-value crops like sugar cane, pineapples, and tobacco, value of production per acre is highest in Queensland.

The southern part of Australia is characterised by a winter rainfall and the southern part of Queensland is situated in a transition zone in which there is a fair winter rainfall. Consequently, the Darling Downs is suited to the growth of both summer and winter crops, although the average annual rainfall is not much more than 25 inches. Apart from the Darling Downs most of the existing agriculture is practised on the coastal side of the Great Dividing Range, where the rainfall is higher and more reliable. The amount of agricultural land in this coastal strip is very much less than people think: a great deal of it is "wallum"—land of low fertility and probable minor element deficiencies—while other large tracts are swampy, although they could possibly be reclaimed by drainage. In fact, it may well be that large drainage schemes could increase productivity nearly as much as irrigation.

The irrigation potential has been discussed earlier. In our present state of knowledge it is not evident that a vast expansion of agriculture will take place on the coastal belt. On the other hand there is a possibility for very great expansion of summer cropping in the great "black" soil belt of some 40 million acres. To do this, however, will need the development of a specialised form of agriculture.

Summing up it would seem that in the existing state of knowledge and practicability of soil treatment there is not more than 50,000,000 acres of agricultural land in Queensland and much the greater part of this could not be intensively farmed owing to the limitations of quantity and distribution of rainfall. From an area point of view, therefore, Queensland must remain predominantly pastoral country. There remains a vast amount of developmental work yet to be done, on grazing and on agricultural lands, and with water resources; the basic need is the population to do this work.

BOTANICAL NAMES OF PLANTS.

Black spear grass	*Heteropogon contortus.*
Blue grasses—	
Forest blue grass	*Bothriochloa intermedia.*
Pitted blue grass	*Bothriochloa decipiens.*
Queensland blue grass	*Dichanthium sericeum.*
Western blue grass	*Bothriochloa ewartiana.*
Brigalow	*Acacia harpophylla.*
Burr medic	*Medicago denticulata.*
Button grass	*Dactyloctenium radulans.*

Flinders grass	*Iseilema membranacea* and other species of *Iseilema*.
Kangaroo grass	*Themeda australis*.
Kikuyu grass	*Pennisetum clandestinum*.
Mitchell grasses—	
Barley Mitchell	*Astrebla pectinata*.
Bull Mitchell	*Astrebla squarrosa*.
Curly Mitchell	*Astrebla lappacea*.
Hoop Mitchell	*Astrebla elymoides*.
Mulga	*Acacia aneura*.
Native sorghums	*Sorghum laxiflorum*, *S. leiocladum*, *S. nitidum*, *S. plumosum*.
Paspalum	*Paspalum dilatatum*.
Prickly pears—	
Common pear	*Opuntia inermis*.
Spiny pear	*Opuntia stricta*.
Rhodes grass	*Chloris gayana*.
Spinifex	*Triodia mitchellii* and *T. pungens*.
Spring grass	*Eriochloa procera* and *E. pseudoacrotricha*.
Townsville lucerne	*Stylosanthes sundaica*.
Wallaby grass	*Danthonia* spp.
White clover	*Trifolium repens*.
White spear grass	*Aristida leptopoda*.

GLOSSARY OF SOIL TERMS.

Profile.—A vertical section of the soil from the surface down to the parent material.

Horizon.—A horizontal layer within the soil profile exhibiting characteristic features of colour, texture, structure, or composition.

Podzol.—A Russian name given to one of the "great soil groups" of the world. The soils are acid throughout the profile, and contain no free lime. The colour of the surface soil is usually grey, and the sub-surface or A2 horizon is bleached. The subsoil is usually a yellow or reddish heavy textured clay resulting from the leaching of the colloids from the A horizon and their translocation and subsequent deposition in the B horizon. The transition from A to B horizon is mostly abrupt.

Solonized Soil.—A soil characterized by a high proportion of sodium in the bases. The consistency of the B horizon, where the sodium tends to concentrate, is hard.

Alluvium.—Soil material deposited by flood waters.

Residual Soil.—Soil formed *in situ* on the parent rock; synonymous with "sedentary."

Laterite.—Hard rock-like material consisting mainly of iron and aluminium oxides with an open cellular structure. It has been derived from the solution of iron and aluminium compounds from the soil and their subsequent deposition and dehydration to form an horizon within the soil profile. The term "lateritic" is often applied to soils consisting largely of iron and aluminium oxides.

Pedocal.—A soil containing free calcium carbonate in the profile.

Loam.—Soil texture grade which may vary as under:—Sand, 50-77 per cent.; Silt, 10-25 per cent.; Clay, 10-25 per cent.

Sandstone.—A rock formed by the cementation of sand grains.

Red Loam (as applied to the red volcanic loams).—A great soil group of the world, characterized by deep soil with little or no differentiation into horizons, red colour due to the presence of free iron oxide, and acid reaction. Though high in clay they behave in the field as loams because of their good structure and open friable tilth.

Red Earth or Red-Brown Earth.—A great soil group, characterized by a development of horizons in the profile and an accumulation of clay and calcium carbonate in the lower horizons. They owe their colour to the presence of free iron oxide. They are formed in zones of seasonal rainfall where leaching of bases is incomplete.

Agriculture in the Callide and Dawson Valleys.

O. L. HASSELL, Senior Adviser in Agriculture.

(*Continued from page* 146 *of the March issue.*)

PASTURES.

Native Pastures.

LIKE those of many other areas, the native pastures in the Callide and Dawson Valleys have deteriorated because of overstocking for long periods. In different districts, the carrying capacity of these pastures at present varies between a beast to ten acres and a beast to twenty acres. The better types of native grasses are very palatable and cattle hold their condition well for a long period on these pastures when they have dried, provided seasonal conditions have been such as to produce a large bulk of grass.

Prominent species among the grasses of the original native pastures on the more fertile soils were Queensland blue (*Dichanthium sericeum*), rare blue (*Bothriochloa intermedia*) and desert blue (*B. ewartiana*). On the less fertile ridges, kangaroo grass (*Themeda australis*), love grasses (species of *Eragrostis*) and scented golden-beard grass (*Capillipedium parviflorum*) were common.

In overstocked areas, the main invading species have been coarse, less palatable grasses such as pitted blue grass (*Bothriochloa decipiens*), wire grasses (species of *Aristida*), black-spear grass (*Heteropogon contortus*), woolly-top Rhodes grass (*Chloris virgata*), and purple-top Rhodes grass (*C. barbata*).

Grass growth after the winter usually commences with storms in the spring and early summer, but in common with most pasture land in Queensland, this early growth may be severely checked by hot weather if storms are too infrequent to maintain reasonably good soil moisture conditions until the wet season commences. Because of the erratic rainfall in the Valleys generally, peak growth of the pastures may occur at any time between January and March. With the approach of winter the native grasses dry off, but they remain palatable to cattle for a considerable period thereafter. Little attempt is made to manage the native pastures apart from ringbarking to reduce competition from trees, and the common practice is to burn following the first summer rains.

Plate 122.

Brigalow Scrub Felled by Axe and Ready for Burning and Sowing to Rhodes Grass, Biloela District.

Plate 123.

Felled Softwood Scrub Country Sown to Rhodes Grass, Upper Callide Valley.— Note the bottle trees characteristic of this area.

Pasture legumes are not uncommon. They include emu grass (*Psoralea australis*), species of *Rhynchosia, Glycine* and *Vigna,* and the introduced phasemy bean (*Phaseolus lathyroides*). All are summer growing types and die in the winter, but the dried residues are readily eaten by stock.

Introduced Pastures.

Many thousands of acres of brigalow and softwood scrubs have been felled, burnt, and sown to Rhodes grass (Plates 122-124). This grass has been a very valuable pasture for dairy and beef cattle since the inception of closer settlement in the Callide and Dawson Valleys, and has been responsible to a large extent for the maintenance of the butter and cheese factories in the Valleys as well as being the chief pasture for rearing and fattening a large percentage of stock for market.

Plate 124.

An Excellent Burn of Felled Brigalow Scrub, Callide Valley.

On a sown Rhodes grass pasture, a reasonable carrying capacity is considered to be a beast to three or five acres. Severe damage to the pasture will follow overstocking, resulting in the invasion of weeds and wire grasses (Plate 125). To restore worn-out pastures, crop rotation is necessary. Especially good crops may be grown following the breaking up of old Rhodes grass paddocks (Plate 126). Further, Rhodes grass planted on old cultivations has given excellent results and there is little doubt that the inclusion of Rhodes grass pastures in crop rotation is a certain method of maintaining highly productive pasture as well as helping to maintain soil structure.

Numerous grasses have been tried experimentally in the Valleys but without irrigation none has shown the same promise as Rhodes grass. Paspalum grows in moist situations along creek flats but does not form an appreciable proportion of the pasture land.

Plate 125.

Rhodes Grass Pasture, on Brigalow-Belah Scrub Country, Eaten Out by Overstocking.

Various introduced legumes have also been tried as pasture components but none has shown much promise with the possible exception of lucerne. A Rhodes grass-lucerne mixture merits consideration, particularly where the Rhodes grass pastures are treated as part of a rotation with cultivated crops.

Plate 126.

Rhodes Grass Pasture Turned Under With a Mouldboard Plough on an Alluvial Flat at Biloela Regional Experiment Station.

WEED PROBLEMS.

The major weed species are black pigweed (*Trianthema portulacastrum*), Johnson grass (*Sorghum halepense*), nut grass (*Cyperus rotundus*), Noogoora burr (*Xanthium pungens*), bull head (*Tribulus terrestris*) and Mexican poppy (*Argemone mexicana*). Suckering of brigalow is a particularly serious problem where brigalow scrub has been felled and burnt.

Black pigweed is very troublesome on cultivated areas. It is a quick-growing, free-seeding annual which rapidly spreads over cultivated land unless checked in the seedling stage. The seed germinates with successive summer rains and the plants resist dry conditions to a high degree, quickly sending forth new growth as soon as soil moisture is replenished. Crop rotation, including a Rhodes grass pasture, clean fallowing, and early cultivation are essential to control the weed.

Plate 127.

Brigalow Suckers, Showing Area Brushed with Axe in Foreground.

Johnson grass has also invaded both Valleys, probably as contamination in Sudan grass seed, and has become a problem on some farms. Sodium chlorate sprays will kill this weed but should be used as soon as infestation is noted, otherwise the treatment of large areas will be too expensive.

Another method of attacking Johnson grass infestations which has given reasonable success is deep ploughing with a mouldboard plough during hot, dry periods in the summer. All the underground stems should then be raked and burnt and further seedling growth destroyed. As Johnson grass seed may remain viable in the soil for several years, seedling growth will recur constantly and must be destroyed promptly before flowering if this method is to give complete success.

Plate 128.

Brigalow Suckers Broken Down with a Tractor and Attached Plough.

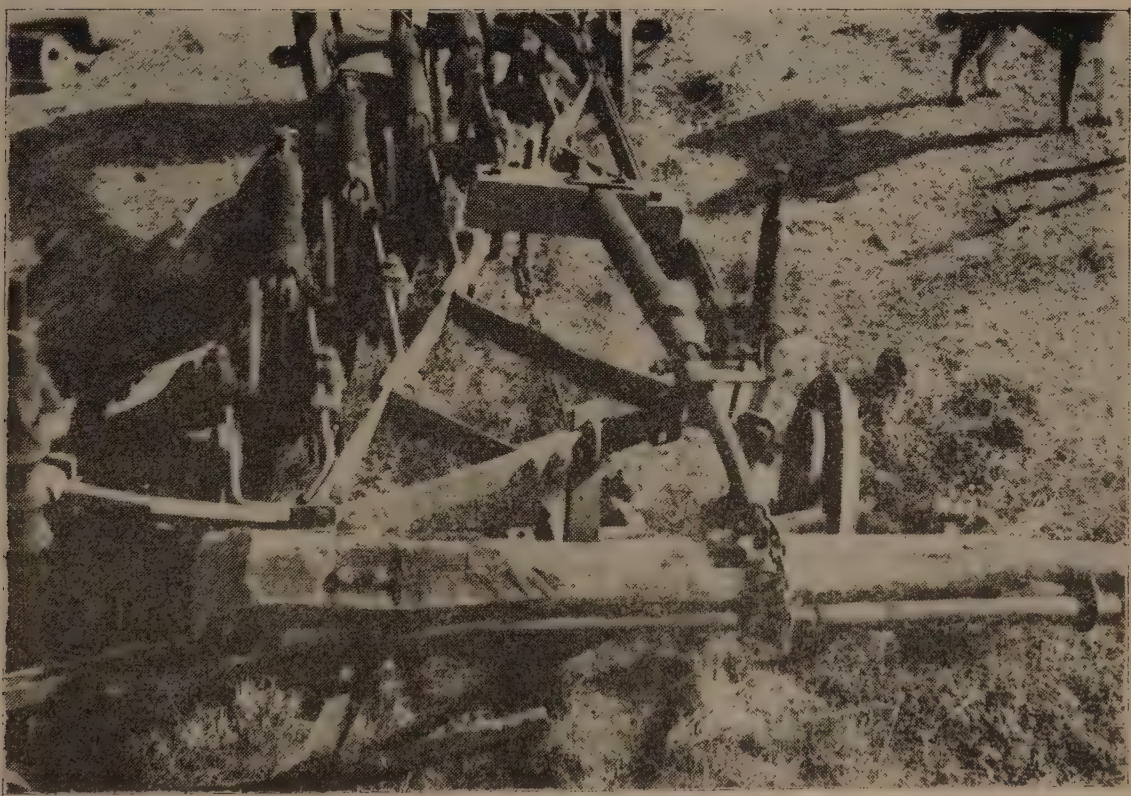


Plate 129.

Showing Method of Attachment of Wooden Beam to Front of Disc Plough for Breaking Down Brigalow Suckers.

Nut grass is mainly troublesome on some alluvial flats. Cultivation during hot, dry weather in the summer and the use of smother crops will temporarily check the growth of this weed.

Noogoora burr is widely spread along creek banks and on alluvial flats and on occasions has been very serious in the Theodore irrigated areas. Hormone weedicides, however, will effectively check this weed and will also kill seedlings of Mexican poppy.

Interest among farmers in the use of hormone weedicides is increasing. Many of the minor weed species such as khaki weed (*Alternanthera repens*) and star burr (*Acanthospermum hispidum*) can be killed by these chemicals.

An entirely satisfactory method for controlling brigalow suckers has not yet been developed. After the falling and burning of the scrub, brigalow regrowth from the roots of stumps and from seedlings is soon established. On certain types of country the regrowth of brigalow may be thicker than the original stand.

Continued cutting of the regrowth tends to increase the sucker population; on the other hand, if left uncut, the area soon becomes overgrown and all pasture is smothered out (Plate 127.) Mechanically clearing the land by bulldozer does not solve the problem, as regrowth will commence from broken roots left in the ground.

Where Rhodes grass is sown on burnt scrub areas and fired each year, the regrowth of brigalow can be held in check. For this purpose the grass should not be overstocked, thus ensuring a good body of grass for firing each year.

If the land, after burning the fallen scrub, is cleared to plough depth and cultivated to row crops, brigalow suckering can be controlled. Care needs to be exercised, however, when the old cultivation is sown to Rhodes grass to provide for regular burning of the grass if brigalow regrowth continues to be a nuisance.

The method of one farmer who has endeavoured to solve the brigalow sucker problem consists of pushing over the regrowth by drawing a heavy multiple disc plough behind a heavy tractor (Plates 128 and 129.) In front of the disc plough is attached a heavy wooden beam which extends beyond the off side of the plough for approximately 2 feet. From the front of the plough to the wooden beam a heavy recoil spring is attached. As the plough is drawn around the paddock, the wooden beam pushes over the brigalow regrowth. On the next round, the tractor and plough pass over the partly broken timber, leaving it in a flattened and partly cut and broken state.

The pushing over of the regrowth is carried out during the winter months, and with the approach of warm weather fodder sorghum seed is sown over the whole area. Sufficient seed usually germinates amongst the debris to give a good cover. This crop is allowed to stand until the following winter, and as soon as the sorghum crop is dry enough the area is fired. Following the burn, the paddock is planted to Rhodes grass. Indications are that with further burning of any regrowth which appears most of the suckers can be eliminated.

AGRICULTURAL CROPS.

The total area under cultivation in the Callide and Dawson Valleys for the year ended June, 1950, was 32,409 acres. As the rainfall mainly occurs in the summer, the general cropping programme is designed to make the most use of summer grown crops. In recent years, wheat growing for grain has expanded, but for the successful establishment of a grain wheat industry, summer fallowing to trap the summer rain in the subsoil to carry the wheat crop through the winter will be necessary.

Plate 130.
Farmlands in the Biloela District.

Grain Sorghum.

The area planted during the 1949-50 season was 6,199 acres, yielding about 150,000 bushels.

Because of its hardiness this crop has rapidly gained popularity in the Valleys. Isolated areas of up to 600 acres are grown by individual farmers. The yield per acre varies considerably with the seasons. In a good season yields of up to 60 bushels per acre are not uncommon. A large quantity of the grain produced is absorbed in Central Queensland for feeding to cattle, pigs and poultry. There is also a keen demand from outside sources for grain from this district.

Crop residues remaining after harvesting and crops which fail to mature grain are commonly used for grazing by stock and have been particularly valuable during drought years.

For many years the variety Kalo (Plate 131) was the most popular, but because of its liability to lodge, it has been superseded by Wheatland. Judging from plantings during recent years it seems that the variety Early Kalo will shortly take the place of Wheatland. Hegari is also grown to some extent, and the new locally bred variety Alpha has been well received by many farmers. Planting takes place usually in November or December, depending on the onset of the storm rains. Earlier and later plantings are made according to the season.

Plate 131.

A Crop of Kalo Grain Sorghum, Callide Valley.

Plate 132.

A Crop of Rain-grown Wheat, Theodore.

Wheat.

The area of wheat planted for grain in the 1949 season was 6,643 acres, yielding over 100,000 bushels. Plantings expanded in 1950.

The returns from this crop have varied considerably in different seasons, but in recent years results have been encouraging. The average yield per acre for all seasons is not high, but in good seasons crops of up to 60 bushels per acre have been produced. No doubt as farmers gain experience with the crop, average yields will improve.

Some of the crop is used in the Central district for feeding to pigs and poultry. The grain is considered to be a first class milling wheat. For some years past the bulk of the planting was made with the variety Three Seas, but other popular varieties such as Puora, Pusa 4, and Charter, are also grown.

Cotton.

The area planted in the 1949-50 season was 1,760 acres, yielding 510,704 lb. of seed cotton.

The early development of the Valley lands under closer settlement was assisted to a large extent by the cotton crop. Brigalow and softwood scrubs were felled and burned and the areas thus cleared were planted to cotton. The seed was planted with hoes and walking stick planters between the stumps and logs on the newly burnt land. The crops were kept clean of weeds by hand hoeing. Rhodes grass seed was sown among the cotton plants in late summer and autumn.

For the first few years cotton was the main cash crop in the Valleys. This practice was followed until a sufficient area of grass was obtained to enable the settler to commence dairying. Cotton growing in the Valleys reached its peak in 1939, when 43,000 acres were planted. Of this area, 32,000 acres were grown in the Callide Valley and the bulk of the planting was made on burnt scrub land.

The cotton acreage in these areas has declined, due mainly to shortage of farm labour, particularly for harvesting, higher prices for other agricultural crops, and less scrub being felled. The introduction of mechanical cotton pickers and a higher price per pound of seed cotton, however, are expected to stimulate an increase in the area planted. On the Theodore Irrigation Area and at the Biloela Regional Experiment Station over 1,500 lb. of seed cotton per acre have been produced under irrigation. The principal varieties being grown in the district at present are strains of Miller, Triumph, and New Mexico Acala. These varieties originally came from the United States of America and by selection work improved strains have been produced. Some jassid resistant strains have also been bred at the Biloela Station.

Maize.

The area planted in 1949-50 was 680 acres, yielding about 10,000 bushels of grain.

Due to the erratic seasons and heat waves in the summer months, the area planted to this crop during the past few years has declined. Many former maize growers have turned their attention to grain sorghum, which has proved to be a more reliable crop in the district. The varieties usually grown are Yellow Dent types and the earlier maturing strains of the so-called Ninety Day group. All the grain produced is used in the district.

Plate 133.

A Young Crop of Irrigated Cotton, Theodore Irrigation Settlement.

Green Fodder Crops.

The area planted to green fodder crops in the Valleys during the 1949-50 season was 15,008 acres.

The shortage of labour on dairy farms has led to an increase in the area planted to crops for grazing purposes. During the summer months the principal crops planted for this purpose are Sudan grass, lucerne, giant setaria, white panicum, maize, sweet sorghums, and cowpea. The principal winter fodder crops grown are oats (Plate 137),

Plate 134.

Cotton Crops in the Callide Valley.

Plate 135.

Portion of an Irrigated Cotton Crop at Biloela Regional Experiment Station which Yielded 1,780 lb. of Seed Cotton per Acre.

Plate 136.

A Rain-grown Crop of Cotton in the Jambin District which Yielded over 800 lb. of Seed Cotton per Acre.

wheat, barley, and field peas. Oats is by far the most widely grown of the winter fodder crops; for early planting, Algerian is favoured, while for later plantings, quick maturing varieties such as Belar, Buddah, and the rust resistant Victoria x Richland are recommended.

Plate 137.

Stock Grazing on Oat Stubble, Theodore.

Hay Crops.

Unfortunately, the number of hay stacks to be seen on farms in the district is small and too many hay sheds remain empty. During the year ended June, 1950, the area planted to crops for haymaking was 747 acres, from which 1,258 tons of hay were produced. The crops grown for haymaking during the summer months are Sudan grass, white panicum, giant setaria, and Japanese millet. The main winter crops grown for hay purposes are oats and wheat (Plates 138 and 139).

Sundry Crops.

In 1949, 143 acres of oats were planted for grain, the main variety used being Sunrise. There is a good market for this grain in the northern towns.

In the same season 67 acres of millet were grown for grain, the favoured variety being white panicum. The grain is sold locally.

The remaining area under crop was planted to lucerne, sweet potatoes, English potatoes, broom millet, pumpkins, and peanuts.

Lucerne is grown in small areas, both with and without irrigation, on the alluvials in the Callide Valley, where it is used mainly for dairy stock. At Theodore, on the irrigation settlement, larger areas are grown both for dairy stock and for the farm produce market. Lucerne

Plate 138.

Haystacks for Dairy Cattle at Biloela Regional Experiment Station.

is such a valuable fodder for stock that the acreage planted to it in both valleys could be expanded with benefit to the dairying and grazing industries.

Sweet potatoes are grown for pig feed mainly, and a small acreage of English potatoes is grown under irrigation, chiefly for local use.

Broom millet is grown in small areas both with and without irrigation. The quality of the hurl harvested is generally high and there is a good demand for the product. At present the demand is considerably in excess of supply.

Pumpkins yield exceptionally well in the district and could be grown much more extensively both for table purposes and for cattle fodder.

Plate 139.

Wheaten Hay in Stacks, Biloela Regional Experiment Station.

In recent years peanuts have been grown to a small extent in parts of the Valleys and there is scope for expansion of this crop.

Some Rhodes grass seed is harvested for sale (Plate 140).

HORTICULTURAL CROPS.

The area planted to horticultural crops for commercial purposes is small. Citrus and grapes have been found to grow very well on certain soils and suitable land exists for further plantings. During World War 2, a considerable volume of vegetables was produced in the Valleys, but production declined when demand eased. Irrigated market gardens in the vicinity of the townships supply a large proportion of local consumption.

Plate 140.

Harvesting Rhodes Grass Seed, Callide Valley.

DAIRYING AND MIXED FARMING.

Mixed farming is the general practice in the Callide and Dawson Valleys. Dairy farming is combined with pig raising, the cultivation of sorghum and wheat for grain, and cotton growing. Although the district is subject to droughts, with most of the annual rainfall occurring in the summer months, it has proved to be well suited to mixed farming, and with increased irrigation facilities and better land management practices production output can be expected to increase considerably.

As a rule, stock carry their condition exceptionally well through the winter months. Where provision is made for fodder conservation, losses in production and stock numbers during droughts are often surprisingly low. In the Callide and Dawson Valleys there were 80,805 dairy cattle in 1950, comprised chiefly of the Jersey and A.I.S. breeds. The herds are generally of good quality, as may be seen from the class of entries at the annual local shows at Thangool, Wowan, Biloela, and Baralaba.

The mainstay of most dairy herds consists of (*a*) native pastures, (*b*) sown Rhodes grass pastures, (*c*) Sudan grass, (*d*) grain sorghum stubble and grain sorghum crops which have failed to head because of insufficient soil moisture or other causes, (*e*) oats, and to a lesser extent wheat, for grazing. Lucerne, usually irrigated, and some other fodder crops are also used to some extent.

Butter factories are operating at Wowan and Biloela, and a cheese factory at Theodore (Plate 141). The Wowan butter factory was established by the Dawson Valley Co-operative Dairy Co. Ltd. in 1919. This company was amalgamated with the Port Curtis Co-operative Dairy Association Ltd. in 1928. This association opened the Biloela factory in 1937 and the Theodore factory in 1942.

As a matter of interest, the production of butter and cheese at Wowan, Biloela, and Theodore over the years since the amalgamation in 1928 is set out in the following table.

Year.	Wowan.	Biloela.	Theodore.
	Butter.	Butter.	Cheese.
	Tons.	Tons.	Tons.
1928–29	386	..	..
1929–30	497	..	..
1930–31	573	..	..
1931–32	603	..	..
1932–33	795	..	..
1933–34	1,299	..	..
1934–35	1,369	..	..
1935–36	1,478	..	..
1936–37	1,236	243	..
1937–38	842	894	..
1938–39	1,412	1,484	..
1939–40	1,071	1,287	..
1940–41	784	1,308	..
1941–42	1,102	1,450	..
1942–43	1,155	1,490	141
1943–44	1,109	1,501	118
1944–45	770	1,355	127
1945–46	910	1,439	126
1946–47	730	1,057	108
1947–48	1,006	1,695	135
1948–49	1,049	1,724	152

When the Biloela factory was opened it was estimated that 65 per cent. of the Wowan district cream supply was diverted to this factory. All the Theodore supply was withdrawn from Biloela when cheesemaking commenced on the irrigation area.

PIG RAISING.

Pig raising is carried out principally in conjunction with dairying. In 1950 there were 15,522 pigs in the Callide and Dawson Valleys. Most of the pigs are absorbed by the two proprietary bacon factories at Rockhampton. Ample opportunity exists for greater pig production in the Valleys.

Plate 141.
The Cheese Factory at Theodore.

FODDER CONSERVATION.

Fodder conservation in the district does not receive the attention it merits. Soils are productive, but seasonal rains are erratic, and therefore it should be the concern of every dairy farmer to make provision in the good years for the unpredictable seasons ahead in order to keep up production. This applies particularly where there are no irrigation facilities for growing fodder crops in dry times. There are too few silos and too many empty hay sheds. During long dry spells fodder is brought into the district for feeding to dairy stock, but good fodder production methods could avoid this expense.

THE GRAZING INDUSTRY.

Statistics for the year 1950 show that there were then 157,119 beef cattle in the Callide and Dawson Valleys. The cattle industry depends mostly on the natural pastures in the district, and to a lesser degree on the sown pastures. Most of the stock are grown and fattened on the natural pastures, which vary in carrying capacity from a beast to 10 acres to one to 20 acres. The grazing properties are generally well improved by subdivision, ringbarking, and the provision of water facilities. Where possible, graziers have felled brigalow scrub and planted these areas to Rhodes grass, which is a valuable adjunct to the natural pastures. On some small holdings crop fattening is being carried out. In this district the breeds used are principally Herefords and a smaller percentage of Shorthorns. Over many years the Hereford has been found suitable to the district with its erratic seasons. Fat stock and store stock buyers are continually in the district and inspect the cattle on the property. Buyers from the Rockhampton meatworks operate in this area.

Banana Growing in Queensland.

J. McGREGOR WILLS, Senior Adviser in Horticulture.

(*Continued from page 158 of the March issue.*)

PLANTING MATERIAL.

THE careful selection of planting material has a considerable bearing on the success or failure of the plantation. It is essential that all planting material be taken from mature, vigorous plants in an area which is free from at least the more important diseases and pests. Wherever possible, growers use their own planting material, because better selection is possible under these conditions.

Two types of planting material (Plate 142), known as "suckers" and "bits," are normally used for planting.

Suckers.—Suckers are offsets from the parent plant. They make excellent planting material provided they are sturdy, of the current season's growth and have retained the "sword" leaves until they are at least eighteen inches high. The persistence of the "sword" leaves is an indication of plant vigour. Suckers about two feet high with a bulb not less than three inches in diameter are preferred in practice; small suckers with a spindly stem and broad, flattened leaves lack vigour and should be discarded as unsuitable for planting.

Bits.—Bits are sections of the mature corm with a prominent, well-developed eye. A number of bits may be cut from a single corm but each should have the eye centrally placed and should be not less than three inches in any dimension. The size of the bit indicates the amount of reserve plant food available to sustain the young banana until it has developed a root system of its own. Bits are considered the best type of planting material available and they are preferred for early plantings owing to their normally rapid growth and the particularly even stand which develops from them.

All suckers or bits should be pared to a depth of about one-eighth of an inch when they are removed from the parent plant. If the planting material is brought from another property, paring should be done on that property. Deep paring, however, should be avoided as it may damage the root zone of the young plant and interfere with its development. If extensive weevil borer tunnels are observed when a corm is cut into bits, the material should be rejected as unsuitable for planting. Corms derived from a plant or first ratoon crop specially grown as a source of bits are the best planting material.

Plate 142.

Banana Planting Material.—Left to right:—bit, sucker, corm. Whole corms are seldom used.

When the planting material, either suckers or bits, has been suitably prepared, it should be graded into at least two, and preferably three, groups for size and then allowed to stand for at least 24 hours before planting. During that period, the cut surfaces dry out sufficiently to prevent any subsequent breakdown. Each grade of bits or suckers should be planted as a block in the new plantation, in order to give reasonable uniformity to the stand and simplify cultural and harvesting operations.

PLANTING METHODS.

The planting positions in the area should be marked out with a long stick cut to the required inter-plant spacing. Planting distances in general use are (in feet) :—

Cavendish	9 x 9 to 12 x 12
Mons Mare and other semi-dwarf varieties	10 x 10 to 14 x 14
Lady Finger and other tall varieties	12 x 12 to 16 x 16

The numbers of plants required per acre at the various distances are approximately :—

9 x 9	535
10 x 10	435
11 x 11	330
12 x 12	300
13 x 13	260
14 x 14	220
15 x 15	190
16 x 16	170

The planting holes should be dug with a sharp mattock at least 15 inches deep and about 18 inches across. If a large stone or stump happens to occupy the planting position, the hole should be dug above the obstacle so that there will be no restriction on the growth of the uphill sucker, which would normally be selected for the ratoon crop.

On hillsides, suckers should be planted with the cut surface facing downhill and bits should be placed with the eyes facing in an uphill direction. By this means the followers can be set on the uphill side of the parent where they penetrate deeply into the soil, giving added firmness to the stool. The planting hole should be partly filled in with loose soil, the sucker or bit placed in position, and sufficient soil added to cover the plant with a layer a few inches deep. As the holes are filled in, the soil should be tramped down firmly around the plant and the hole only filled to within about six inches of the top so as to leave a depression at the planting position.

FERTILIZING.

When large areas of virgin rain forest were still available the land was cropped until returns became unprofitable, and the grower then cleared and planted a new area. Fertilizers were seldom, if ever used. Now the use of fertilizers is essential on many plantations to maintain a level of soil fertility at which profitable crops can be produced for a reasonably long period. The banana is a gross feeder and makes heavy demands on the available plant foods in the soil, particularly during the first three months after planting and after suckers are set for ratoon crops. A fertilizer with the formula 8:10:8 or thereabouts is suitable for most of the soils in southern Queensland on which bananas are grown, the rate of application being half a ton per acre for the plant crop and one ton per acre each year for ratoon crops.

In the plant crop, the first application should be made within a week or so after planting at the rate of 1-1½ lb. per stool. Two additional applications of one pound per stool should also be made at intervals of approximately two months. The first fertilizer application is made in a band two feet wide around the stool and not closer than one foot from its base. Succeeding applications should be made further from the base of the plant and in a wider band, since the root system develops outwards as growth proceeds. In ratoon crops, it is usual to double the rate of application. The first dressing is made in spring after the followers are set, and the fertilizer is distributed in a wide band between the two rows.

In plantations on open forest or replant land where the fertility level is probably low, an additional dressing of two ounces of sulphate of ammonia may be given with beneficial results to plants lacking in vigour. These supplementary dressings to backward plants may, if necessary, be applied each month for three or four months and do much to induce a uniform bunch development in the plantation.

Plate 143.

Cover Crop of Poona Pea in Lady Finger Bananas at Pimpama.

On the red volcanic soils which are extensively used for banana production, dressings of ground limestone or dolomite are often applied with good results at intervals of about three years. Both materials aid in the decomposition of spent stems and old leaves; they also improve the texture of the soil, reduce its acidity and normally assist in making available essential nutrients to the plant. Both ground limestone and dolomite are broadcast at the rate of $1\frac{1}{2}$ to 2 tons per acre about a month before the spring fertilizer application. This period is particularly suitable if a cover crop is to be sown in October.

COVER CROPS.

In recent years, interest in cover cropping for banana plantations has increased, but the practice is still more or less limited to districts characterised by a relatively heavy rainfall, such as Tallebudgera and Currumbin. In these districts, Poona pea (Plate 143) is used, but some of the newer cowpea strains such as Reeves Selection should be equally if not more satisfactory, particularly when previous plantings have suffered from wilt. The green manure crop reduces the loss of surface soil from erosion, and also suppresses weed growth during the summer months, so that little chipping or hoeing is necessary before April when the crop has matured and died. In districts with a rainfall under 50 inches per annum, cover crops may compete with the bananas for the available soil moisture during dry periods.

In a bearing plantation the best results are obtained by growing cowpeas in bands 4 to 5 feet wide across the slope between every alternate row of bananas. If the seed is sown in moist soil at a rate of 20 lb. per acre, and either chipped in or buried with a rotary hoe operated with a shallow cut during late October, the legume can be established very quickly. In young plantations from which bunches will not be cut during the summer months, the whole area may be sown.

Plate 144.

Pigeon Pea, a Reconditioning Crop for Old Banana Land.

During the period of most vigorous growth, usually late January and February, routine brushing may be necessary to prevent the cowpea from overgrowing the banana plants. The amount of brushing required depends mainly on the variety of cowpea used, and is relatively slight with Reeves Selection, Brabham, Victor or other strains with a semi-erect habit.

RECONDITIONING OLD LAND.

In the past, old banana land has often been allowed to develop a natural cover of lantana. This plant is slow to establish itself and also difficult to remove when the land is required for replanting bananas. A tall perennial legume which makes rapid growth when the plantation is abandoned and which can both suppress undesirable weeds and enrich the soil during the resting period would be much better than lantana. Of the many plants which might be suitable for this purpose, pigeon pea (Plate 144) is likely to prove the best.

Particularly good results have been obtained with this crop in the South Coast district. If the plantation is to be dug out in winter, the crop is sown in the preceding September or October. The seed may be broadcast at a rate of 8 lb. per acre and then ploughed or rotary hoed into the ground. On relatively steep slopes where implements cannot be used, the seed may be hand hoed into the ground at a rate of approximately 16 lb. per acre. When the plants are twelve months old and the first crop of seed has been harvested, the pigeon pea is cut back to 18 inches above ground level. Regrowth will soon renew the ground cover and within a few months the plants will be 9 to 10 feet high. The dense stand of pigeon pea effectively smothers out weeds such as stinking roger and cobbler's pegs, but wild tobacco can hold its own against pigeon pea and should, therefore, be dug out when necessary. The cover crop may be left on the area for several years until the land is required for replanting.

When bananas are again to be planted the pigeon pea may be brushed to ground level about three months before planting is expected to begin. As the mulch decomposes fairly rapidly, planting should be relatively easy. Under no circumstances should the brushed material be burned; any regrowth which appears after the bananas are planted can be grubbed out during routine cultural operations.

WEED CONTROL.

Weeds are apt to be troublesome in plantations established on replant land and on virgin land where the burn has not been satisfactory. As the weeds develop rapidly and compete with the young bananas for soil moisture and plant nutrients, efficient control measures are necessary. On most farms, particularly those on steep slopes, weed control is done entirely by hand hoe; on lesser slopes or on flat land, horse-drawn or power implements can be used effectively. Cultivation must be shallow, for deep cultivation may injure the root system and reduce the productivity of the plantation. In any system of cultivation, the need for conserving surface soil must always be a major consideration even in hand operations such as chipping—for example, chippers should work towards the plant and drag the soil across the slope rather than down the slope.

If the rainfall is heavy, efficient chipping in summer is sometimes impracticable. Weedicides may then be used to keep weed growth in check. Arsenic pentoxide and sodium arsenite are used extensively in Queensland for the purpose at strengths (usually 1 lb. of arsenic pentoxide in 4 gallons of water or 1 pint of liquid sodium arsenite in 5 gallons of water) which are specified by the manufacturers. Two applications should be sufficient to control weed growth at that time of the year if made at intervals of approximately one month. The sprays are applied at the rate of 60 to 80 gallons per acre on a calm dry day. Care must be taken to keep the spray away from the bananas.

Organic weedicides such as 2,4-D should not be used for the control of weeds in banana plantations as wind drift from any type of spray apparatus may cause considerable injury to the crop.

During the first year in the life of a plantation, weeds should not be allowed to seed. If they are effectively controlled then, chipping costs will be considerably reduced later on. During the wet season,

when competition for moisture is not a limiting factor to plant growth, the weeds may be brushed before they seed, if chipping is impracticable and weedicides cannot be effectively used. The brushed weeds left on the surface of the soil act as a mulch and reduce erosion to some extent during heavy rains. Under normal conditions, one man should be able to keep five acres of bananas free from excessive weed growth from planting onwards.

Plate 145.

Setting the First Ratoon Sucker.—A deep sucker for the first ratoon crop is normally set in November, when the parent plant is about twelve months old.

CROP CONTROL.

In recent years, plantation management has aimed at increasing the productive life of the plantation. One important method of achieving this is a rigid programme of desuckering. In effect, desuckering the banana plant is a form of pruning which has as its objects:—(*a*) the removal of surplus suckers; (*b*) the development of the follower in the desired position; (*c*) the control of bunching and cropping; (*d*) opening up the stool so that the sun has access to base of the plant; and (*e*) an improvement in the quantity, size, and quality of the fruit.

Efficient desuckering is influenced by the grower's knowledge of local climatic and soil conditions and their joint influence on the rate of plant development.

Selection of the Follower.

Modern preference is for the selection of one follower from each parent plant for the ratoon crop (Plate 145). Under this system of management, the number of bunches per acre is controlled in order to ensure that the bunches will be large, carry fruit of good quality, and mature during periods of the year when market prices are highest.

Plate 146.

Setting the Second Ratoon Sucker.—The deep sucker set for the second ratoon crop is in line with the original and first ratoon plants. Note the worthless shallow sucker (" sitter ") at right centre position.

On very fertile soils, two suckers may be allowed to develop for the first ratoon crop, but only one sucker should be set from each plant in succeeding generations. In less fertile soils, it is customary to set only one sucker for both the first and subsequent ratoon crops.

Normally, the sucker selected for the first ratoon crop should appear above ground between September and November, when the parent plant is about half to two-thirds grown and has not yet thrown its bunch. Under good conditions in southern Queensland, these suckers produce fruit which should be harvested 18 months later. The selected sucker should be deep-seated and this characteristic is

usually indicated by a position well out from the base of the parent plant. It should be spear-shaped with a large bulb and narrow, sword-shaped leaves. A deep-seated sucker will develop a substantial root system at the soil depth most suited to the plant. On hillside country a sucker situated more or less uphill from the parent corm should be selected, as it is less likely to be exposed by erosion of the surface soil.

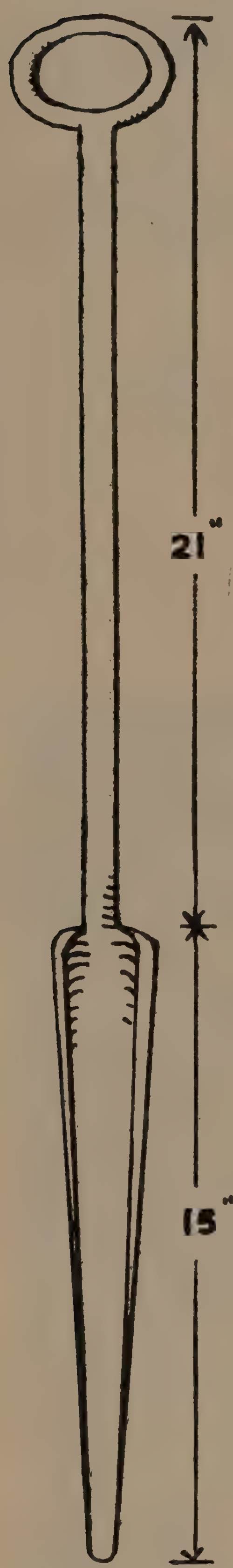


Plate 147.

Desuckering Tool.

Shallow-seated suckers always lack vigour and rarely produce good plants. The most shallow-seated type (Plate 146), commonly known as a "sitter," arises from a bud at or just below ground level, and produces a corm more or less on the surface of the ground. The root system in shallow-seated suckers is restricted and often proves totally inadequate for the needs of the plant. Suckers of this type should be rigorously suppressed. In southern Queensland, a current season's Cavendish follower should have reached 18 inches in height by the end of December; the Mons Mare follower should be 30 inches in height at the same time.

Desuckering.

All sucker growth arising from the plant prior to or after the selection of the desired follower should be removed as soon as possible after its appearance. If allowed to remain on the parent plant, these unwanted suckers delay cropping and adversely affect yields. During spring and summer, when sucker growth is rapid, it will be necessary to desucker the plantation at least once a month; during autumn and winter, when growth is less vigorous, desuckering at intervals of two or three months will be sufficient.

Desuckering may be done with a special gouge. The type shown in Plate 147 has a blade curved in cross section, tapering to the point, and sharpened on both sides. Small suckers and "peepers" are easily destroyed by forcing the gouge through the growing point, and giving it a complete turn; such treatment suppresses further growth in the offshoot without in any way injuring the root system of the parent plant. Plants that are a foot or more in height should first be cut off at ground level and the centres hollowed out to a shallow cone with a suitable gouge. When the central core has been removed, the cavity may be filled with kerosene; about one-third to one-half tea-spoonful is sufficient to complete the destruction of the sucker without injuring the parent plant. A mixture of half kerosene and half sump oil gives better results than does kerosene alone.

PROTECTING THE BUNCH.

Propping.

During the wet season, when strong winds frequently accompany heavy rain, the normal root system of the banana is often incapable of supporting a plant carrying a heavy bunch and, unless the plant is propped, it may be blown over and the bunch lost. Cavendish bananas require less propping than Mons Mare and Williams Hybrid, and Lady Fingers rarely need propping at all.

Props are best placed in position as soon as the last hand on the bunch has opened. The safest type is a double prop (Plate 148), made from two pieces of timber of equal length fastened together by a bolt or piece of wire about a foot from the end. When the legs are spread the top forms a "V" in which the bunch stalk is held; this supports the bunch firmly and, no matter how rough the weather, the prop cannot fall away and leave the bunch unsupported. Another satisfactory type of prop may be made by boring a hole about 6 inches from the end of the prop, and passing about 2 feet of No. 8 or No. 10 gauge wire through so that the ends project beyond the end of the prop, to which the wire is firmly stapled. When placed under the neck of the bunch the wire forms a "U" and holds the bunch firmly. Forked saplings may be used as single props, but they are difficult to obtain and rarely last more than one year.

Plate 148.

Propping the Bunch.

Pointed props struck into the side of the pseudostem or the bunch stalk should not be used; they give little support, and during rough weather the movement of the plant either dislodges the prop or forces it deeply into the tissue and the bunch may even snap off as a result.

When placing the prop in position, it is usual to remove all dead leaves. If allowed to remain, they tend to choke the stool, restrict sucker growth, and favour the development of diseases. It is also advisable to remove all dead leaves at intervals, particularly during the winter, so that as much sunlight as possible may reach the developing sucker. The bunch flower should be removed when the bunch is about half matured, as its retention only increases the weight of the bunch.

Bagging.

In southern Queensland, bunch covers can be used to advantage, particularly in exposed plantations. During the winter months, fruit blemishes are common and considerably reduce the value of even well-filled fruit. Bunches protected by suitable covers are invariably free from these blemishes and the fruit develops and matures more evenly than it would otherwise do. On plantations where leaf spot or speckle causes severe defoliation in the autumn, the fruit in exposed bunches may be scalded by exposure to the sun before it has reached a marketable stage. In practice, covers should be fitted not only to the bunches on partially defoliated plants but to all bunches which are likely to be harvested between May and September.

Chaff bags and corn sacks make suitable covers if the bottom of the sack is cut open, slipped up over the bunch and tied firmly around the stalk above the top hand. The other end of the bag is left open so that the fruit can be easily examined as the bunch approaches maturity. Heavy paper bags are specially manufactured for covering banana bunches and these may be used if desired. Unlike the hessian bags, they can only be used for a single season and may prove unserviceable during very wet, cyclonic weather accompanied by high winds. The use of bunch covers increases production costs in the plantation but the additional capital outlay is amply repaid by the high quality of the fruit and the increased market returns.

MARKETING THE FRUIT.

A grower should aim at building up confidence between the buyer and himself by marketing only high grade fruit. To this end, only fully matured bunches of well-filled fruit should be harvested. However, bunches should not be left on the plant until the fruit begins to colour or the fingers are so full that they split when being packed.

Cutting.

A bunch is ready to cut when the fruit is nicely rounded without showing prominent ribs and the dead tips break off readily when rubbed (Plate 149.) Thin, angular, immature fruit should not be harvested under any circumstances. Experience will soon enable a grower to judge the stage of maturity at which to harvest in order to obtain top market prices.

Plate 149.

Bunch Ready for Cutting.—The fruit has lost its former angular shape and the tips are dead.

For cutting bunches a cane knife, reaping hook, or large butcher's knife may be used. With the Cavendish variety the leaves are first cut away to give freedom of action, and the bunch stalk is then severed above the top hand by a downward stroke of the knife, leaving sufficient length for easy handling. Mons Mare and other tall varieties require a different technique, the exact method depending on whether or not the plant has been propped. If it is propped, a small "V" cut should

first be made in the pseudostem on the side towards which the plant is leaning and about 6 feet from the ground. This allows the stem to sag with the weight of the bunch and the prop may be used to lower it until the bunch can be cut comfortably. If the plant has not been propped a slanting cut is made half-way through the pseudostem at a suitable height. This allows the plant to sag sideways and the "tail" or flower end of the bunch may be caught and used to guide the bunch down until it can be cut easily.

After cutting, the bunches are usually taken to every fourth row and placed on heaped leaves to avoid injury to the fruit. They are then carried to points from where they can be wired or carried by slide or yoke to the packing shed. Wherever workable, wiring systems are to be preferred, as they permit rapid transport of the fruit from the field and cause less damage than other methods.

Packing.

While the packing shed need not be an elaborate and expensive structure, it should be constructed in such a way that the fruit can be handled and packed in comfort under hygienic conditions. The framework may consist of bush timber and the sides of slabs, but a good iron roof and a wooden floor are essential if the shed is to be kept clean.

As the bunches arrive at the packing shed they may be stacked and allowed to sweat, or the fruit may be handed off and allowed to stand in the hands. The sweating period is at least eight hours, but it is probably better to dehand the fruit, allow it to stand overnight, and then pack the next day. After each consignment has been despatched, all damaged and waste fruit, together with any refuse, should be cleared away and dumped some distance from the shed.

Market practice depends on both the variety of banana grown and the distance of the plantation from the market centre. In Queensland, most of the fruit grown locally is marketed in the bunch, and is delivered by road transport direct from the plantation. Consignments of bananas to more distant markets are usually packed in the standard 1¼ bushel cases as "singles" or less commonly, as "hands." The skill shown by growers in harvesting and packing the fruit is reflected in its appearance on the market floor.

ARTIFICIAL RIPENING.

Fruit showing colour in the plantation cannot stand the handling it receives between harvesting and the time it reaches the consumer. As indicated earlier, the bunch is cut when the fruit in the more forward hands has lost its angular appearance.

The need for uniformly ripened fruit in the retail store is such that most of the bananas reaching the more important distribution centres are artificially ripened in special chambers with coal gas or other accelerators. Ripening practices vary, but fairly good results are obtained in Cavendish and Mons Mare with concentrations of coal gas at 0·1 to 0·3 per cent., a relative humidity of 85 per cent., and temperatures of 60-65 degrees F. The normal treatment period is about 5-7 days. The Lady Finger variety may be ripened under similar conditions but will stand higher temperatures and gas concentrations than the Cavendish types.

LEGISLATION.

From time to time outbreaks of bunchy top, leaf spot, beetle borer, and rust thrips have caused heavy losses which influence production for some years in particular areas. To cope with this situation appropriate legislation has been provided in "*The Diseases in Plants Acts,* 1929 *to* 1948," and "*The Banana Industry Protection Acts,* 1929 *to* 1937." The more important legislative matters which concern the grower may be summarised as follows:—

(1) Bananas may not be planted unless permission has first been granted by the Banana Industry Protection Board through one of its several agents stationed in the more important producing districts. Such permits are granted if the proposed planting is in conformity with the planting policy issued by the Secretary for Agriculture and Stock in August each year. The planting policy defines permissible sources of planting material in each district and the treatment, if any, which such material must have before it is used.

(2) Diseased plants must be treated as prescribed. The grower must treat bunchy top infected plants with kerosene and then dig up and destroy both the plant and any others associated with it in the one stool. He must also report outbreaks to the Department of Agriculture and Stock.

(3) Plantations must be kept to the satisfaction of an Inspector, who may take any necessary measures to ensure eradication of diseased plants. The occupier or, where there is no occupier, the owner of the land, must dig out or otherwise completely destroy a banana plantation at the end of its cropping period.

JUNIOR FARMERS' ORGANISATION.

Twelve representatives of Junior Farmer Clubs took part in the annual "leadership" competition for the title of champion junior farmer of Queensland conducted by the Australian Broadcasting Commission at its Brisbane studios on 1st and 2nd March.

The winner was Ron. Elliott, of the Monto Club, with a grand total of 119 points, from P. P. Kelly (Tully) with 116 points and E. B. Horne (Wondai) with 111 points. The other finalists were J. J. Coombes (Bauple) and M. T. Hogan (Eton North). Other club representatives were John Beutel (Brigalow), Marshall T. Muller (Clifton), Roy French (Wowan), Doug. Cribb (Gayndah), Ron. English (Malanda), John Penigas (Kairi-Danbulla), and Lyle Bennett (Samsonvale).

About 30 nominations were received for the selection of five junior farmers to represent Queensland at the Sydney Royal Show as the guests of the Royal Agricultural Society of New South Wales. The members chosen were F. G. Brady (Bowen), Neville E. P. Fowler (Coalstoun Lakes), Mervyn Sokoll (Wondai), Harold Nicholson (Sarina), and David Dodds (Goondi).

Feeding Requirements of Dairy Calves.

R. W. HEWETSON, Assistant Husbandry Officer, and R. D. CHESTER, Officer in Charge, Cattle Husbandry Branch.

CALVES should be fed rations which contain the right kind of high quality nutrients in quantities sufficient for normal growth and development, but for economical production these nutrients should be provided at the lowest possible cost.

Having selected calves from high producing cows, it is necessary to raise the animals in such a way that they have the opportunity to develop their frame, so that when mature they will have the capacity to produce. The growing animal should be maintained in strong active condition. Underfeeding results in small "weedy" heifers unable to consume enough feed to produce more than a few pints of milk. Over-

Plate 150.

A Healthy Calf Which Has Received Adequate Colostrum.

feeding results in grossly over-developed heifers tending rather to beef production and coarseness than to the production of milk, and often difficult to get in calf.

To ensure that calves thrive and grow normally, the animals' requirements of protein, energy, minerals, and vitamins must be fully met.

PROTEIN REQUIREMENTS.

The proteins are complex nitrogenous compounds made up of simpler substances called amino-acids. Of the twenty-two known amino-acids only ten have been found to be essential for growth.

Most of the gain in weight in young dairy animals is made up of the high-protein substances contained in lean or muscular tissue. It has been shown that the protein content of gains made by young animals fed enough nutrients for normal growth with little or no fattening is 20 per cent. for a calf of 100 lb., decreasing gradually to 14 per cent. for an animal weighing about 1,000 lb.

The amount of protein required for normal growth by young dairy stock of the same age and size may vary widely depending on the nature of the ration and the quantity fed.

A minimum quantity of protein is required if the ration provides ample energy and protein that contains all the essential amino-acids.

Protein of the highest quality is provided by milk and milk by-products.

Hay proteins are usually low in one or more of the essential amino-acids. Grains usually supply the essential amino-acids lacking in hay and these two classes of feed combine well to furnish protein of good quality for growing stock. Where high-protein concentrates are used to balance the ration, they increase the variety of amino-acids and tend to ensure a protein mixture of higher quality for the growing animal. Especially is this so where high-protein meals of animal origin are used in the mixture.

Initially, the calf requires a high-protein diet. This can be reduced gradually as the animal matures. Thus, in calf starters it is wise to have 20 per cent. crude protein. This can be reduced to 16 per cent. by the time the calf is six to eight weeks old, and after four months the protein in the ration may be further reduced.

While the calf is still young, it is necessary to supply some protein of animal origin. Calves which are to receive no milk after eight to ten weeks of age require a meal mixture which contains an animal protein, such as dried skim milk, dried buttermilk, blood meal or meat meal. Only small quantities of these meals are necessary to produce satisfactory results.

After four months of age, lucerne hay alone is sufficient as a source of protein if grazing is also available.

ENERGY REQUIREMENTS.

In feeding growing dairy cattle it is necessary to provide sufficient starch equivalent or total energy for maintenance and normal growth. Energy is used up in the processes of digestion and metabolism, in maintaining temperature of the body at blood heat, and in breathing and exercise.

At birth, the calf has a small stomach, the rumen being undeveloped, and all food material being passed directly to the abomasum or fourth stomach. For this reason, it requires its food in concentrated form or in a liquid form. As the rumen develops, more and more feed of a roughage nature can be eaten. Thus, during the first few days milk alone is digested. After about two weeks, the calf will begin to eat a little grain and pick at pasture and hay; but it is not until it is five to six months old that it will make the best use of roughage feeds alone.

Recent work in America indicates the necessity for calves to take in necessary bacteria before the rumen will utilize efficiently the purely roughage foods such as hay. The calf normally picks up these organisms when grazing behind adult cows. However, where limited milk feeding is undertaken and calves are forced to consume large amounts of roughage early in life, rumen inoculation may be beneficial. Rumen inoculation is the transfer of cud material from an adult animal to the calf, thereby transferring large numbers of useful bacteria from the adult rumen to that of the calf.

It has also been noted that those calves raised free of rumenal bacteria have developed "pot bellies" and rough coats.

MINERALS AND VITAMINS.

Several mineral elements are essential for normal development of the calf, but those which require special attention on the part of calf raisers are calcium (lime), phosphorus, sodium and chlorine, the last two of which are found in salt. Both lime and phosphate are adequately supplied by milk, but if milk can only be given in limited quantities it may be necessary to feed either ground limestone, to make up for the calcium, or bone meal, which will supply phosphate and some calcium.

The results of many experiments indicate that normal calf rations of hay and grain supply sufficient lime and phosphate for normal growth. There have been indications from various areas that, especially in dry years, phosphate deficiency exists in some soils producing forages which are particularly low in phosphorus, and in some areas actual phosphorus deficiency has been demonstrated in animals fed home-grown roughage.

A calcium-phosphorus imbalance in calf meals may interfere with the absorption of these minerals. It is important that the calcium and phosphorus content of the prepared meal be as near as possible to a ratio of one part of calcium to one part of phosphorus. Foodstuffs rich in lime are lucerne hay and good pasture. Wheat, bran, and linseed meal are very rich sources of phosphorus, as are most of the grains.

Because most vitamins are synthesised by cattle in the rumen, vitamin A is the only vitamin which is likely to be deficient. At birth the young calf is deficient in vitamin A and nature has intended that the newborn calf should receive most of its vitamin A from colostrum and milk. Colostrum contains seventy times as much vitamin A as does ordinary milk. The chief role of this vitamin is to keep all tissues in a healthy state so that they will resist infection.

The vitamin A content of colostrum will vary with the vitamin A intake of the springing cow or heifer. The main sources of vitamin A supplement available will be young green growing grass and good

quality lucerne hay. The sources of vitamin A available to the young calf are colostrum, green pasture, rich green lucerne hay, and yellow maize. A good feed of colostrum in the first twenty-four hours of life, followed by the dam's milk for the first seven days, is usually sufficient to carry the young calf on until it begins eating grass. An excess of vitamin A is stored in the liver to be used at a later date when vitamin A supplies have dropped in quantity.

SUPPLEMENTARY FEEDING STUFFS.

The important supplements to be fed in addition to milk or whey are pasture, hay, grain, and, to a lesser extent, protein-rich concentrates.

Plate 151.

Calves Should be Rotationally Grazed to Make Greatest Weight Gains.

Pasture.

Pasture forms the chief supplement in normal calf-raising methods on Queensland farms. Good pasture is cheap and contains adequate nutrients to balance the milk diet. If immature, rapidly growing pasture is available, it may be used to replace all hay recommended in the ration, and after the first twelve weeks calves will thrive on milk and good quality pasture without a grain ration. However, if good pasture is not available, some hay should be fed and the grain ration should continue until calves have matured sufficiently to ensure that they are capable of dealing with roughage containing a high fibre content.

After the initial training period, which lasts two or three weeks, calves should be placed in a well-grassed paddock where they have ample shade and fresh water and constant access to good grazing. A

young lucerne or cereal crop provides excellent grazing for calves. It is desirable that facilities should be available for rotational grazing of such paddocks or of alternating young stock with mature cattle. Constant stocking with young animals leads to heavy contamination with eggs and larvae of internal parasites. Rotational grazing will eliminate the build-up of heavy worm burdens and at the same time provide a much better plane of nutrition.

Rotationally grazed calves make better daily gains and produce more milk and butterfat during the first lactation and in subsequent lactations.

Plate 152.

Well Grown Heifers on Irrigated Pasture.

Hay.

In the absence of good grazing, some hay is essential if the calf is to make normal growth. Good lucerne hay will supply large quantities of protein, calcium, and vitamin A, three food constituents essential to health and growth.

In the absence of pasture, calves should have constant access to good hay. It is unwise to limit the intake of roughage. At about four weeks, the normal calf will eat approximately 1 lb. of hay per day; at three months 3 lb., and at six months about 5 lb.

If good quality hay is available on the farm, it may be used to replace some of the grain portion of the ration. However, overfeeding on rich leafy lucerne hay will sometimes scour calves.

Hay is best fed in hay racks or in wide bins. Racks should be protected from the weather and trays should be provided underneath to collect dropped leaf. The leaf is the most valuable source of vitamin A and protein.

Concentrates.

Grain forms the bulk of most concentrate meals fed to calves; and, indeed, if adequate milk is available, protein-rich concentrates are not required, as the milk-grain ration is quite well balanced.

Cracked or crushed grains alone are sometimes slightly unpalatable, and in order to increase palatability it is wise to add a little bran or peanut meal to the mixture if these are available.

Even if good pasture is available, calves will thrive better if given some grain in their ration. The amount fed will depend to some extent on the availability and price, but when grain can be grown on the farm it is profitable to feed it in relatively large quantities.

Calves should be started on grain as soon as they begin to cud—at about three weeks of age. Calves raised on limited milk should be encouraged to eat at the end of the first week. Grain rubbed on the nose or placed in the mouth will encourage calves to eat early.

It is wise to feed the grain ration immediately after the milk drink, as this avoids bolting of the mixture and also lessens the tendency for calves to suck one another when the milk is finished.

Most grains are of equal value as calf foods, and farmers should be guided only by availability and price when making their selection of a grain to feed. Grains which become floury when crushed may be less palatable to calves. Yellow maize has an advantage in that it contains vitamin A, but in ordinary circumstances this vitamin will be supplied by the pasture.

The grain should be ground into a coarse meal rather than to a flour.

In areas where molasses is available cheaply, it may be used as portion of the concentrate meal. To avoid scouring, start with small quantities. As little as 1 oz. per day, mixed with grain, is sufficient. Build this up, gradually, until a maximum of about 2 lb. per day is fed at six months. It is advisable to avoid molasses in the case of whey feeding.

Protein-rich meals and mill offals are necessary in the concentrate ration when there is insufficient milk.

Where no milk protein is fed, animal protein in another form must be fed for the first twelve weeks, after which time calves are capable of obtaining their full protein requirements from vegetable sources.

A calf meal found to be very suitable for raising calves on limited milk is:—

Ground Maize	25 lb.
Crushed Oats	25 lb.
Bran	25 lb.
Oil Meals	10 lb.
Meatmeal	15 lb.
Salt	1 lb.
Steamed Bone Meal	1 lb.
Ground Limestone	1 lb.

This meal should contain approximately 20 per cent. protein.

TABLE 1.

GRAIN MIXTURES FOR YOUNG CALVES.

Grain and Concentrate.	10 to 12 Per Cent. Protein. (Calves on Adequate Milk).			14 to 16 Per Cent. Protein. (Calves on Limited Milk).			18 to 20 Per Cent. Protein. (Calves on Whey or Meal).		
	(A)	(B)	(C)	(A)	(B)	(C)	(A)	(B)	(C)
Corn	1	1	1	2	2	1	2	1	1
Sorghum	..	1	1	2	2	1	1	..	1
Pollard	..	..	1	..	2	..	1	2	1
Bran	..	..	1	1	1	1	1	1	1
Linseed Meal	..	..	..	1	1	1	4	2	2

(Figures refer to parts by weight of the constituents listed.)

Table 1 (adapted from the United States Department of Agriculture Year Book for 1939) sets out suggested concentrate rations suitable for feeding with adequate milk, limited milk, and whey or meal. Under A, B, and C, three mixtures in each group are suggested.

Calves getting adequate skim milk require a concentrate ration containing only 10 per cent. crude protein. If the quantity of milk is limited, the protein content of the concentrate should be increased up to about 15 per cent. On a basic ration of whey, or when minimum milk is to be used and calves are raised largely on whey or meal, then 18 to 20 per cent. of crude protein is required.

The maize and oats in the table may be replaced wholly or in part by other grain, and linseed meal may be replaced wholly or in part by other protein meals provided the equivalent amount of crude protein is supplied. Linseed meal, however, has the advantage of being highly palatable, a feature which is not shared by meatmeal or blood meal.

Plate 153.

Calves Raised on Limited Milk Plus a Concentrate Mixture Containing 20 per cent. Protein.

TUBERCULOSIS-FREE CATTLE HERDS (AS AT 20th MARCH, 1951).

Breed.	Owner's Name and Address of Stud.
Aberdeen Angus ..	The Scottish Australian Company Ltd., Texas Station, Texas
A.I.S.	F. B. Sullivan, "Fermanagh," Pittsworth D. Sullivan, "Bantry" Stud, Rossvale, *via* Pittsworth W. Henschell, "Yarranvale," Yarranlea Con. O'Sullivan, "Navillus Stud," Greenmount H. V. Littleton, "Wongalea Stud," Hillview, Crow's Nest J. Phillips and Sons, "Sunny View," Kingaroy Sullivan Bros., "Valera" Stud, Pittsworth Reushle Bros., "Reubydale" Stud, Ravensbourne
Ayrshire	L. Holmes, "Benbecula," Yarranlea J. N. Scott, "Auchen Eden," Camp Mountain
Friesian	C. H. Naumann, "Yarrabine Stud," Yarraman J. F. Dudley, "Pasadena," Maleny
Jersey	W. E. O. Meier, "Kingsford Stud," Rosevale, *via* Rosewood J. S. McCarthy, "Glen Erin Jersey Stud," Greenmount J. F. Lau, "Rosallen Jersey Stud," Goombungee G. Harley, Hopewell, Childers Toowoomba Mental Hospital, Willowburn Farm Home for Boys, Westbrook F. J. Cox and Sons, "Rosel" Stud, Crawford, Kingaroy Line R. J. Browne, Hill 60, Yangan P. J. L. Bygrave, "The Craigan Farm," Aspley A. Verrall and Sons, "Coleburn Stud," Walloon R. J. Crawford, 'Inverlaw Jersey Stud," Inverlaw, Kingaroy

1951 SHOW DATES.

April.

Tara	3 and 4
Miles	5, 6 and 7
Wandoan ..	9 and 10
Toowoomba ..	14 to 19
Goomeri ..	19 and 20
Blackbutt ..	20 and 21
Jandowae ..	23 and 24
Dalby	26, 27 and 28
Monto	27 and 28
Warrillview ..	28
Nanango ..	26, 27 and 28
Goondiwindi ..	28 and 30
Taroom ..	30, May 1 and 2

May.

Kingaroy ..	3, 4 and 5
Barcaldine ..	3 and 4
Beaudesert ..	4 and 5
St. George ..	4 and 5
Wallumbilla ..	4 and 5
Mundubbera ..	4 and 5
Longreach ..	8, 9 and 10
Roma	9 and 10
Gayndah ..	9 and 10
Ipswich ..	8, 9 and 10
Murgon ..	10, 11 and 12
Biggenden ..	15 and 16

May—continued.

Mitchell ..	16 and 17
Blackall ..	15, 16 and 17
Thangool ..	17 and 18
Marburg ..	18 and 19
Kilkivan ..	18 and 19
Charleville ..	23 and 24
Gympie ..	24, 25, and 26
Biloela ..	24, 25 and 26
Crow's Nest ..	25 and 26
Kalbar	26
Maryborough ..	31, June 1 and 2
Wowan	31, June 1 and 2

June.

Boonah ..	1 and 2
Childers ..	4 and 5
Bundaberg ..	6 to 9
Mt. Morgan ..	7, 8 and 9
Lowood ..	8, 9 and 11
Gin Gin ..	11 and 12
Gladstone ..	14, 15 and 16
Toogoolawah ..	15 and 16
Rockhampton ..	20 to 23
Kilcoy	22 and 23
Mackay ..	26, 27 and 28
Esk	29 and 30
Proserpine ..	29 and 30

Brucellosis Testing of Swine.

The Department of Agriculture and Stock is operating a scheme whereby pig herds are tested at intervals for the occurrence of swine brucellosis (contagious abortion).

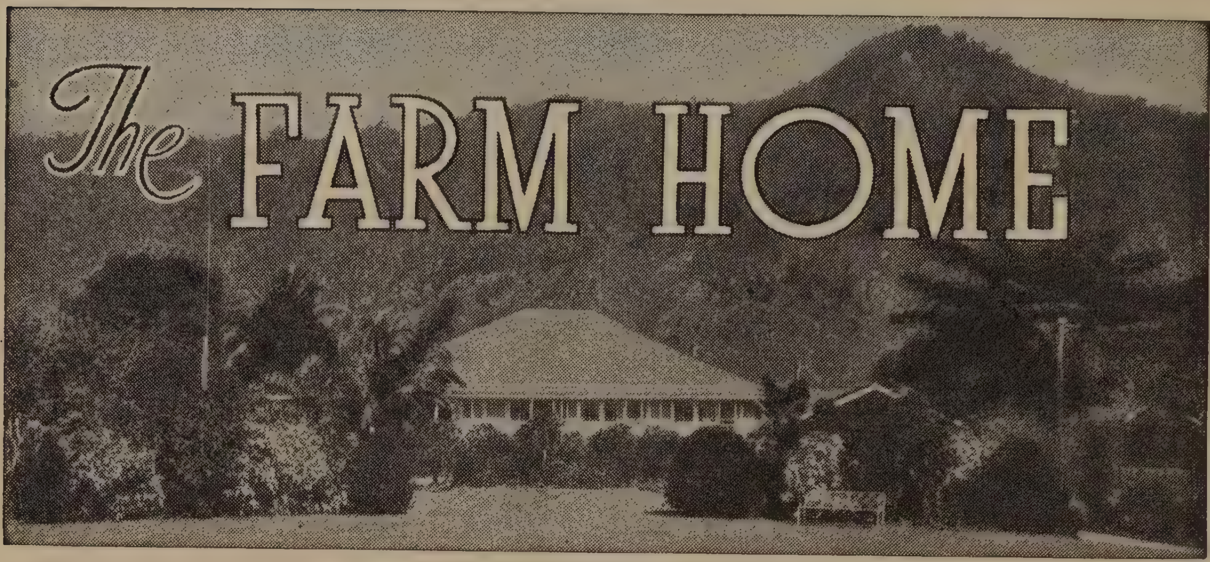
A herd listed by the Department as ''brucellosis tested'' is one in which all such animals as may be determined by the Director of the Department's Division of Animal Industry have been subjected to two successive tests for brucellosis, at intervals determined by him, without any positive reactors being found.

In order for a herd to be retained on the list of Tested Herds, a semi-annual or annual re-test of the herd, as determined by the Director, is required. If at a re-test any animal gives a positive reaction to the test the herd is removed from the list; it is not listed again until subsequent tests, as determined by the Director, have been carried out.

Full particulars of the Brucellosis Testing of Swine and application forms may be obtained from the Under Secretary, Department of Agriculture and Stock, William Street, Brisbane.

TESTED HERDS
(AS AT 20th MARCH, 1951).

Breed.	Owner's Name and Address of Stud.
Berkshire	S. S. Ashton, " Scotia " Stud, Pittsworth J. J. Bailey, " Lucydale " Stud, East Greenmount S. Cochrane, " Stanroy " Stud, Felton Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield G. Handley, " Handleigh " Stud, Murphy's Creek J. L. Handley, " Meadow Vale " Stud, Lockyer R. G. Koplick, " Melan Terez " Stud, Rochedale H. V. Littleton, " Wongalea " Stud, Crow's Nest O'Brien and Hickey, " Kildurham " Stud, Jandowae East E. Pukallus, " Plainby " Stud, Crow's Nest G. C. Traves, " Wynwood " Stud, Oakey E. Tumbridge, " Bidwell " Stud, Oakey Westbrook Farm Home for Boys, Westbrook H. W. Wyatte, Rocky Creek, Yarraman
Large White	H. J. Franke and Sons, " Delvue " Stud, Cawdor Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield F. L. Hayward, " Curyo," Jandowae J. A. Heading, " Highfields," Murgon K. B. Jones, " Cefn " Stud, Pilton R. G. Koplick, " Melan Terez " Stud, Rochedale R. Postle, " Yaralla " Stud, Pittsworth E. C. Smith, " Smithfield " Stud, Coomera
Tamworth	S. Kanowski, " Miecho " Stud, Pinelands N. R. Potter, " Actonvale " Stud, Wellcamp D. F. L. Skerman, " Waverley " Stud, Kaimkillenbun
Wessex Saddleback ..	W. S. Douglas, " Greylight " Stud, Goombungee D. Kay and P. Hunting, " Kazan " Stud, Goodna E. Sirett, " Iona Vale " Stud, Kuraby C. R. Smith, " Belton Park " Stud, Nara



Home Safety Rules.

Issued by the Department of Health and Home Affairs.

Burns and Fires.

1. Take care with matches, cigarettes and naked lights.

2. Never use inflammable liquid inside the house. It is preferable not to use petrol for cleaning purposes even outside the house, as the fumes travel quite a distance.

3. Keep fires guarded and see that the guard is adequate. For electric fires the single or double bars so commonly provided are quite inadequate. The fire should be completely covered with a wide mesh guard fixed to the fireplace and standing away at least 2 inches from the element.

4. Have your electrical appliances checked regularly to make sure there are no loose connections, frayed electric cords or short circuits. Always turn off the current and disconnect the appliance after use. Don't touch electric switches, &c., when your hands are wet. Switches should be out of reach of children. Any portable electric apparatus or light in the bathroom or scullery should be kept well away from bath, sink or pipes; any metal parts should be earthed.

5. Keep tops of stoves and ovens free from grease.

6. Keep a cloth handy for holding hot dishes.

7. Be particularly careful when handling hot fat or a steaming kettle.

8. Keep chimney flues swept regularly.

Scalds.

1. Do not carry hot liquids unnecessarily, but when doing so make sure your way is clear.

2. Keep boiling liquids, teapot, kettle, &c., out of the way of children. Turn all spouts inwards or out of reach of children.

3. A long overhanging tablecloth is a great temptation to a young child. Many children are scalded to death through pulling a hot teapot or other vessel off the table. Secure the cloth to the table by clips or use a tablecloth which does not overhang the edges of the table.

4. Always put cold water in the bath first so that there is no risk if water is upset or has to be left momentarily. Test water with your elbow before bathing baby.

5. Never leave buckets or tubs of water uncovered where a young child may fall in and be scalded or drowned.

ASTRONOMICAL DATA FOR QUEENSLAND.

MAY.

Supplied by W. J. Newell, Hon. Secretary of the Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			MINUTES LATER THAN BRISBANE AT OTHER PLACES.					
Day.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	6·13	5·17	Cairns	12	46	Longreach	28	42
6	6·16	5·13	Charleville ..	25	29	Quilpie	36	34
11	6·19	5·09	Cloncurry	38	61	Rockhampton ..	2	18
16	6·21	5·06	Cunnamulla ..	31	28	Roma	16	18
21	6·24	5·04	Dirranbandi ..	21	17	Townsville ..	11	38
26	6·27	5·02	Emerald	13	26	Winton	31	50
31	6·29	5·00	Hughenden ..	23	47	Warwick	5	4

TIMES OF MOONRISE AND MOONSET.

At Brisbane.

Day.	Rise.	Set.
	a.m.	p.m.
1	1·29	2·28
2	2·28	2·58
3	3·24	3·27
4	4·20	3·56
5	5·15	4·28
6	6·12	5·02
7	7·10	5·41
8	8·06	6·24
9	9·02	7·12
10	9·54	8·04
11	10·41	8·59
12	11·24	9·56
	p.m.	
13	12·02	10·53
14	12·37	11·50
15	1·09	..
		a.m.
16	1·39	12·47
17	2·10	1·45
18	2·42	2·45
19	3·18	3·48
20	3·59	4·56
21	4·48	6·07
22	5·46	7·20
23	6·51	8·31
24	8·01	9·36
25	9·11	10·31
26	10·19	11·17
27	11·23	11·56
		p.m.
28	..	12·30
	a.m.	
29	12·22	1·01
30	1·19	1·30
31	2·15	1·59

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

Charleville 27; Cunnamulla 29; Dirranbandi 19; Quilpie 35; Roma 17; Warwick 4.

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Day.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	23	16	39	32	14	8	45	36
6	13	27	28	43	2	18	31	51
11	9	30	25	44	0	20	26	53
16	17	22	33	38	8	13	37	44
21	29	11	45	26	20	1	52	29
26	26	12	42	27	17	2	49	30
31	16	23	32	39	8	14	36	45

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	38	23	56	45	41	30	32	20
3	27	33	49	54	33	38	23	29
5	17	44	41	60	26	46	15	37
7	8	52	36	65	21	50	8	44
9	2	56	33	67	17	53	3	46
11	3	53	34	66	18	51	4	44
13	10	46	37	61	22	47	9	38
15	20	36	43	55	28	40	17	31
17	30	31	51	51	35	36	25	26
19	42	18	58	43	43	27	35	17
21	53	7	67	35	50	21	44	8
23	56	2	68	32	52	17	46	3
25	51	5	65	34	49	20	42	6
27	40	15	57	41	42	26	33	14
29	34	27	54	48	38	33	29	23
31	23	38	46	56	30	41	20	33

Phases of the Moon.—New Moon, 6th May, 11.35 a.m.; First Quarter, 14th May, 3.32 p.m.; Full Moon, 21st May, 3.45 p.m.; Last Quarter, 28th May, 6.17 a.m.

On May 15th the sun will rise and set 22 degrees north of true east and true west respectively, and on the 2nd and 17th the moon will rise and set close to true east and true west respectively.

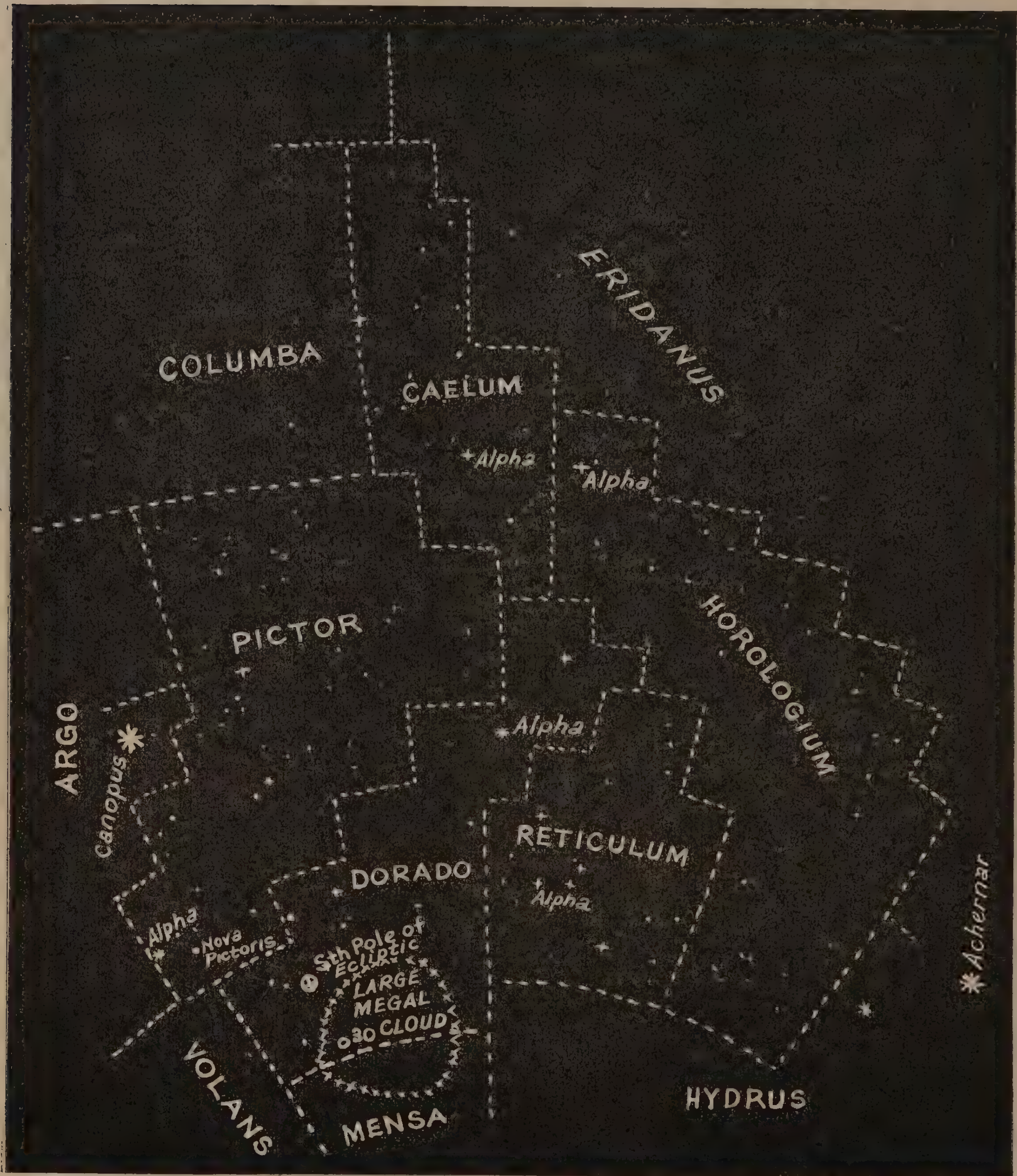
Mercury.—A morning object all this month, in the constellation of Aries. On the 1st it will rise ¾ hour before the sun and by the 22nd will reach greatest angle west of the sun, when it will rise nearly 2 hours before sunrise about 12 degrees north of true east. By the end of the month it will still be rising 2 hours before the sun.

Venus.—Remains a conspicuous object in the western evening sky. On the 1st, in the constellation of Taurus, will set 2¼ hours after the sun and will pass close to Nath about the 3rd. On the 11th, it will enter the constellation of Gemini, and by the end of the month will form patters with Castor and Pollux.

Mars.—Will be in line with the sun on the 22nd and is thus unobservable.

Jupiter.—Now a brilliant object in the morning sky in the constellation of Pisces. At the beginning of the month it will rise 2 hours 51 minutes before the sun and on the 3rd the moon will pass 3 degrees to the north. At the end of the month it will rise between 1.45 a.m. and 3 a.m.

Saturn.—Now well up in the eastern sky at nightfall, setting between 2.45 a.m. and 4.15 a.m. at the beginning of May and between 12.45 a.m. and 2.15 a.m. at the end of May.



THE CONSTELLATIONS.

Between Eridanus and Argo lie several modern inconspicuous constellations as shown in the sketch.

Caelum (The Sculptor's Chisel). Its brightest star is only 4.5 magnitude.

Dorado (The Swordfish or Goldfish) precedes the Carina section of Argo round the South Pole. Though it does not contain any notably brilliant stars, it holds the South Pole of the Ecliptic and part of the large Magellanic cloud—the smaller cloud lies in Toucanus. These clouds were noticed by early navigators from the Cape of Good Hope and were called the "Cape Clouds." Later they were named after the man who first fully described them—Ferdinand Magellan. The large cloud contains many interesting objects, double stars, globular clusters and variable stars. On nights of exceptionally good seeing it is possible to see the Looped Nebular round star 30 Doradus with the naked eye.

Horologium (The Clock).—The brightest star is only 4th magnitude.

Pictor (The Painter).—Originally Equuleus Pictoris, in The Painter's Easel. Contains a Nova ("new star") discovered by R. Watson in South Africa on 25th May, 1925. That day its magnitude was 2.3. On the next day it rose to 1.7 magnitude (nearly as bright as Beta Crucis). The next day its brightness fell to 3rd magnitude. It again brightened to 1.1 magnitude by 9th June and fell to 4th magnitude on 4th July, rising again to 1.9 on 9th August. Its brightness faded until on 25th December, 1925, it was only 6th magnitude. In March, 1928, it was found to consist of two nebulous components 0.5 seconds of arc apart. In 1935 it fell to 9th magnitude, at which it has remained. Examination of photographic plates taken of this area prior to the discovery of the nova showed that from 1911 to 1925 its magnitude was 12.

Reticulum (The Net).—Originally Reticulum Rhomboidalis, The Rhomboidal Net. The largest star in this group is only 3rd magnitude.

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DEPARTMENT OF AGRICULTURE

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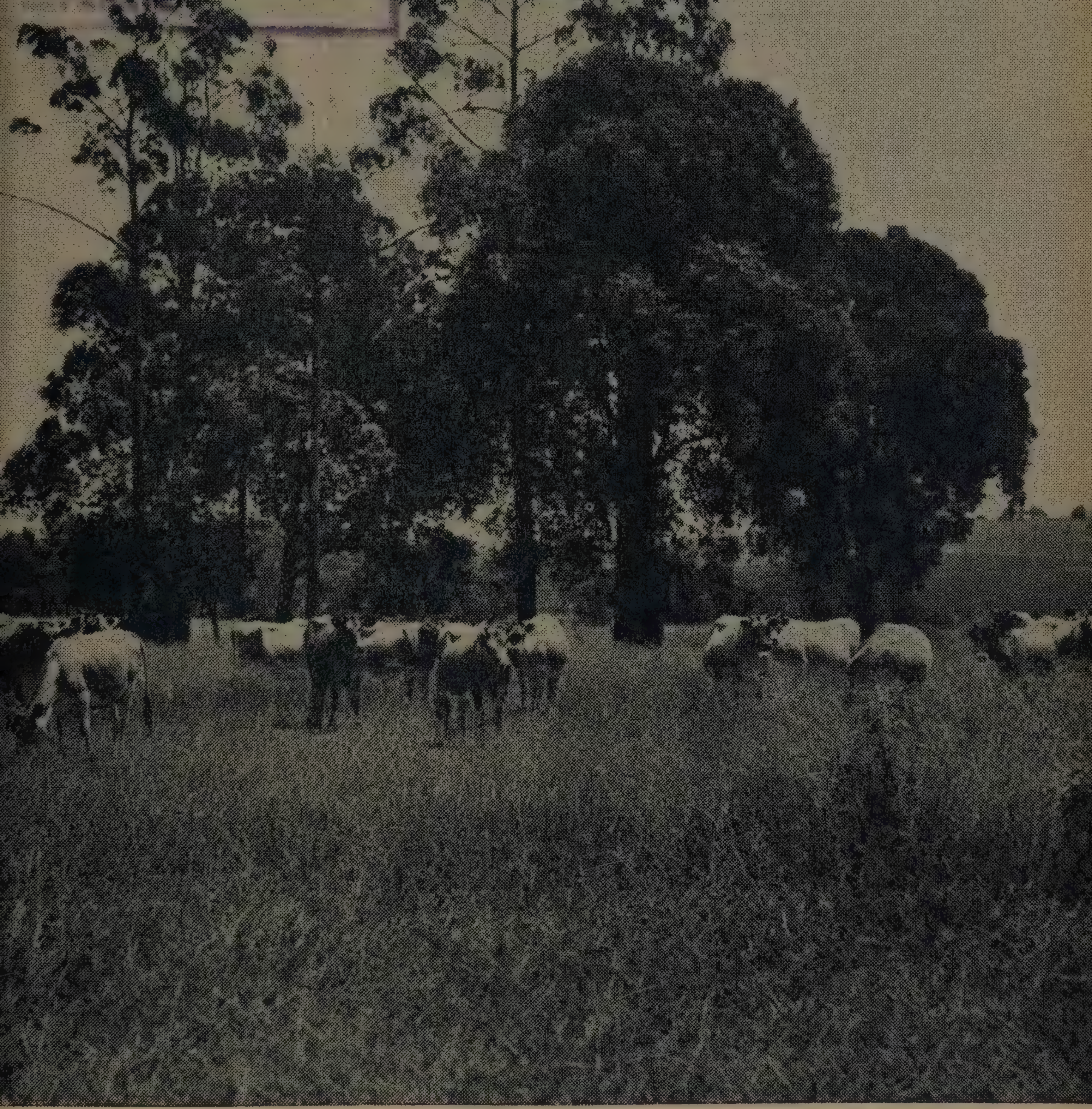
Aus. 12



A South Burnett Dairy Pasture.

LEADING FEATURES

Agriculture in the South Burnett

Root Crops

Cleaning Milking Machines

The Sheep Blowfly

Sterility in Cattle

Registered at the General Post Office, Brisbane, for transmission by Post as a Newspaper.

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Volume 72 Part 5

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C. W. WINDERS, B.Sc.Agr.

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MINISTER FOR AGRICULTURE AND STOCK

GOVERNMENT PRINTER, BRISBANE

Contents

Agriculture in the South Burnett.

J. A. KERR, Plant Breeder.

THE history of the development of the South Burnett commenced with the establishment of the big station properties a little over a hundred years ago. Prior to 1846, Haly Bros. occupied and developed Taabinga Station, with an area of approximately 305 square miles. Burrandowan, Nanango, Barambah, Wigton, Mondure, Tarong and other large stations also date from that period. Apparently, the first signs of closer settlement date back to 1883, and from that year until 1904 was the truly pioneering period of the South Burnett.

Farm produce, such as maize, had to be transported by German waggon to the nearest rail head—Kilkivan, Esk or Jondaryan—with consequent poor nett returns to the producer in many cases. The first cream was forwarded by road to Kilkivan and thence by rail to Maryborough in 1901.

A boom in timber accelerated land clearing from 1900 to 1910 and this was possibly the biggest single factor associated with the closer settlement of the district.

Extensions of the railway to Wondai in 1902 and to Kingaroy late in 1904 were landmarks in the history of the South Burnett. Later, branch lines were constructed from Murgon to Windera and Proston, and from Kingaroy to Tarong and Nanango.

Earliest development of the South Burnett was associated principally with sheep, but these were superseded by beef cattle, which are still of major importance in the district. Agricultural development led to the district being the most important maize producing centre in Queensland. The value of dairying to the district is reflected in the production of the five large butter factories. In the early twenties, a new era of prosperity commenced with the expansion of the peanut industry. The value of the 1947 peanut crop exceeded £1,000,000.

The boundaries of the South Burnett are approximately the Coast Range and Jimna Range on the north-east and east, the Blackbutt Range on the south, the Bunya Range on the south-west to west, and a

line up to and along latitude 26 degrees to rejoin the Coast Range. The area included exceeds 4,000 square miles, and is composed principally of undulating country, the greater portion of which has an altitude in excess of 1,000 feet.

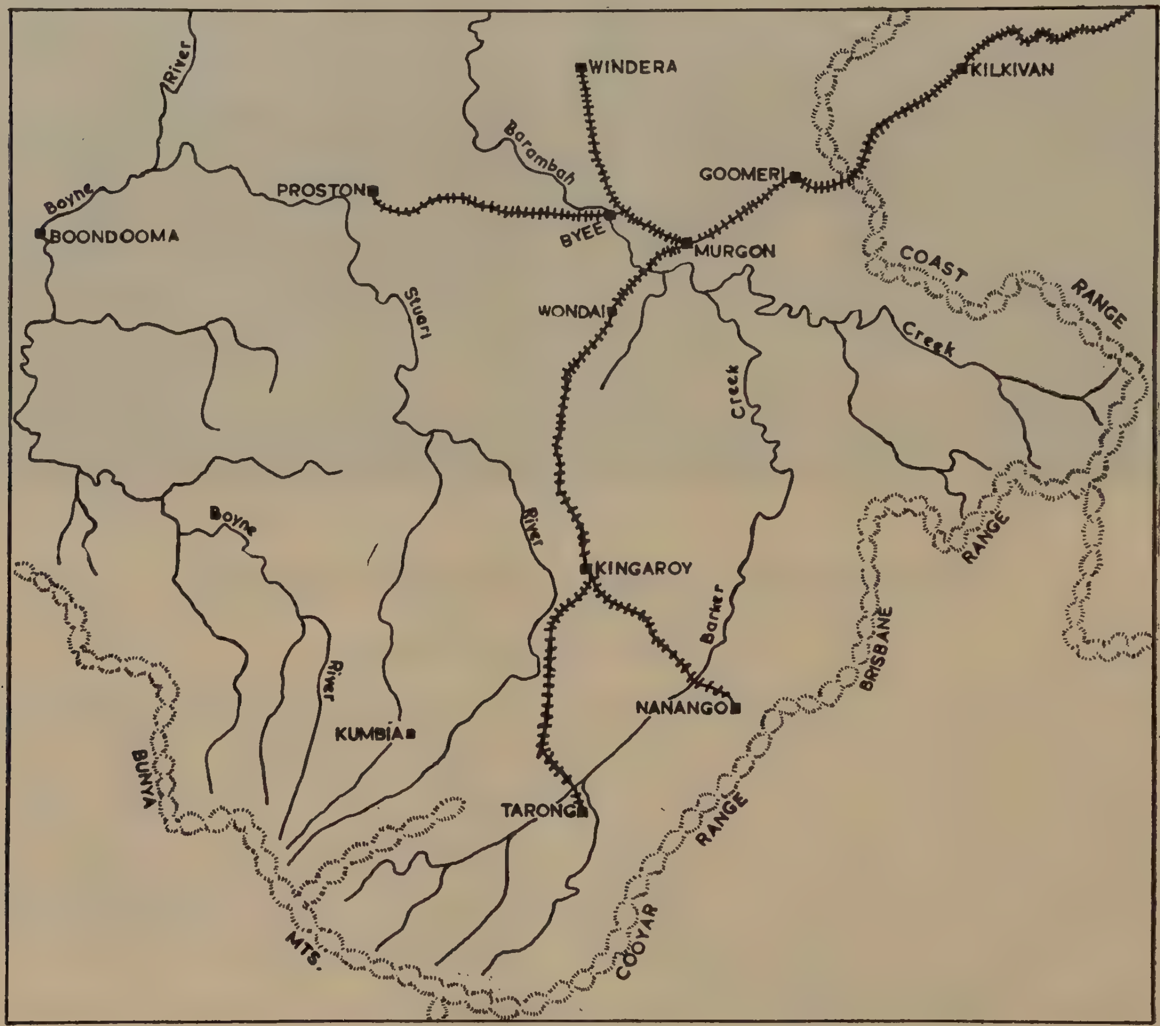


Plate 154.
Sketch Map of the South Burnett District.

By far the greater proportion of farm land in the South Burnett is freehold, only a small proportion being perpetual lease or other form of Crown lease.

Plate 155.
Farmlands in the Coolabunia District, Near Kingaroy.

Centrally situated in the district is Kingaroy, in which the dominant feature is the group of peanut silos, symbolising the importance of the peanut growing industry to the town and district. Murgon, Nanango, Wondai, Goomeri, Proston, Yarraman and Kumbia are strategically situated to service the farming and grazing community.

The principal watercourses of the district are Barker's, Barambah and Boonara Creeks and the Boyne and Stuart Rivers, all of which have many tributaries. Although normally the streams run during the wetter portion of the year only, they are rarely completely dry.

VEGETATION.

With the exception of land held by the Forestry Sub-Department in the Yarraman district, practically all of the rich rain-forest land has been cleared to form the backbone of maize and peanut production combined with dairying and pig raising. This luxuriant rain forest was originally composed of a wide range of plant types and was similar to the rain forest found near the coast east of Gympie and on the highlands of the Blackall Range.

The adjacent open hardwood forest mainly consists of species of eucalypts associated with a wide range of native grasses. The better class forest country has also been closely settled, and there are few possibilities of expansion in these parts of the district.

In addition to the rain forest and open forest types of vegetation, an extensive area of brigalow and belah forest occurs in the Durong and Boondooma districts.

Plate 156.

Mixed Farming Country Near Coolabunia. The Rhodes grass in the foreground was sown on rain forest land.

Of the estimated 4,000 square miles in the area under consideration, probably little more than 500 square miles could be included in the total area suitable for cultivation, and this would include a very large area of second class country with limited agricultural possibilities. Large areas of this second class country are now being cleared by machinery and used for the production of peanuts and grain sorghum

and for dairying. Further expansion of agriculture in the South Burnett is restricted almost entirely to this class of country, and it appears that the balance of agriculture and grazing will change little in the future.

CLIMATE.

Fairly high temperatures are generally recorded throughout the summer months, with considerable variation in the relative humidity. Winter temperatures are generally low, with a high number of frosts during the period from May to mid-August, portion of the district enjoying the doubtful honour of closely following Stanthorpe's minimum recordings in this regard.

The district average rainfall varies from 25 to 30 inches. At Kingaroy the average is approximately 28·8 inches, of which 73·6 per cent. falls during the six months from November to April. This preponderance of summer rainfall automatically determines the range of crops grown in the district, and accordingly winter cereals are of minor importance in the South Burnett. However, while the summer rainfall

TABLE 1.

CLIMATIC DATA FOR SOUTH BURNETT CENTRES.

RAINFALL—(POINTS).

—	No. of Years.	Jan.	Feb.	Mar.	April.	May.	June.
Kingaroy	37	484	327	321	165	111	190
Murgon	33	522	364	272	189	137	214
Nanango	68	465	393	342	193	155	195
Wondai	34	516	330	264	170	122	211
TEMPERATURES—(°F.).							
Mean Maximum.							
Kingaroy	3	85·0	83·6	79·9	74·1	70·9	65·8
Nanango	22	85·1	83·9	81·2	77·3	71·4	66·6
Mean Minimum.							
Kingaroy	3	59·4	63·5	61·8	50·7	43·8	38·1
Nanango	22	62·6	62·0	58·5	50·5	42·5	38·4
RELATIVE HUMIDITY—(PER CENT.).							
Kingaroy 9 a.m.	3	62	74	80	74	74	78

RAINFALL—(POINTS).

—	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Kingaroy	140	92	152	201	291	408	2,882
Murgon	132	86	142	234	332	452	3,076
Nanango	165	129	291	219	286	386	3,099
Wondai	143	97	152	237	339	483	3,064
TEMPERATURES—(°F.).							
Mean Maximum.							
Kingaroy	66·3	69·1	72·7	79·4	82·5	84·3	76·1
Nanango	66·0	69·3	74·6	80·5	84·0	85·5	77·1
Mean Minimum.							
Kingaroy	35·1	38·8	44·9	52·6	56·6	63·9	50·7
Nanango	36·7	36·9	43·6	50·7	57·0	60·6	50·0
RELATIVE HUMIDITY—(PER CENT.).							
Kingaroy 9 a.m.	76	71	62	60	60	68	70

average would indicate satisfactory totals for production of most summer crops suited to this climate, the establishment of these crops is dependent on storm rains occurring from October to January. Storm rains, however, are most erratic and irregularly distributed, and frequently are only sufficient for planting in isolated portions of the district until late in the planting season; late planting entails the risk of destruction of the crop by frost before maturity.

Table 1 gives official rainfall averages for Kingaroy, Murgon, Nanango and Wondai and in addition temperature averages for Kingaroy and Nanango. No temperature records are available from Murgon or Wondai and those for Kingaroy are available for three years only. Local unofficial records, however, show a highest reading of 109 degrees and a lowest grass minimum of 8 degrees.

SOILS.

The most important agricultural belt coincides with volcanic flows, principally basaltic, which have formed an undulating topography. The slopes are gentle with broad ridges. The belt extends from Yarraman to Proston; it is approximately 70 miles long and varies in width from 3 to 15 miles. In addition to the main belt, there are several ''islands'' of basaltic origin, such as the Tablelands (near Murgon) and Dangore Mountain. The soils are classified as red loams, the general features of which are relatively great depth, with little or no evidence of differentiation into horizons in the profile. The red colour is due to the presence of free iron oxide formed in the weathering processes. Locally, the soils are divided into two classes and are described as scrub and forest. The former is associated with the rain forest vegetation and the latter with the open hardwood eucalypt forest.

Plate 157.

A Farm Residence in the South Burnett.

The scrub soils invariably occur on the more elevated areas of the undulating landscapes and the forest soils on the lower slopes. Scrub soils are slightly acid to neutral, mostly well supplied with plant foods, and are highly productive. The forest soils are mostly moderately acid

and though fairly fertile are not so highly productive as the scrub soils. There is a tendency for the formation of a subsoil of higher clay content in the forest soils.

The soils in the natural state all have a well developed granular crumb structure, are free working and friable, and though readily permeable to water have a fair moisture holding capacity. The structure of the forest soil is less stable than that of the scrub soil.

Up to 10,000 acres of rich alluvial soil are found along Barker's, Barambah and Boonara Creeks. The area of brigalow and belah scrub in the Durong and Boondooma districts is associated with a brown to dark grey clay to clay loam soil, occasionally with melon-hole formation. The balance of the district consists mainly of sandy loam to gravelly loam ridges of fair fertility, used principally for grazing. These areas usually contain a number of small but fertile alluvial flats.

SOIL EROSION.

Soil erosion has been a serious problem, especially in the red soil belt. These soils were reasonably resistant to erosion in their virgin state, largely because of their good structural development, but intensive cultivation and lack of suitable crop rotation have destroyed the soil structure. A large acreage of this soil is on slopes of from 5 to 8 per cent., and sheet and rill erosion have removed much of the top fertile soil.

First steps to control this erosion mechanically were taken in the 1939 season. They involved the use of contour banks and water diversion channels. The success of these early projects created considerable interest in the district and led to the adoption of similar methods of erosion control by many farmers.

Plate 158.

View of Wooroolin Country from the Memerambi Road, Near Kingaroy.

The control of erosion, however, on these soils must always be dependent on satisfactory cropping practices. The suitability of Rhodes grass (*Chloris gayana*) for the scrub soil indicates a simple effective rotation. Broadly speaking, the suggestion is to plant 10 per cent. of

available cultivation with a perennial grass (preferably Rhodes grass) each year, leaving each area in grass for three years before returning to crop, and rotating the various cultivated crops within the remaining seven-year period. This rotation will do much to improve and maintain soil structure and fertility. Variations in cultivation methods designed to incorporate the maximum quantities of crop residues into the surface soil are also recommended. Where virgin sloping land is brought into cultivation, the immediate adoption of both mechanical control measures and crop rotation is recommended. Under any circumstances, of course, crop rotation is highly desirable.

WATER FACILITIES.

While the portion of the South Burnett devoted primarily to grazing is fairly well watered by creeks, the main dairying and agricultural belt is dependent on underground water supplies for stock purposes. Generally little difficulty is encountered in locating satisfactory underground supplies.

A large number of irrigation plants are found along Barker's and Barambah Creeks. A plan to weir Barambah Creek has been prepared and on completion should increase production in these areas.

PASTURES.

The native pastures are composed of a wide range of species, including the following:—Queensland blue grass (*Dichanthium sericeum*), pitted blue grass (*Bothriochloa decipiens*), forest blue grass (*Bothriochloa intermedia*), kangaroo grass (*Themeda australis*), love grasses (species of *Eragrostis*), burr grass (*Cenchrus*), spear grasses (species of *Stipa* and *Aristida*) and reed grass (*Arundinella*).

There is also a large range of native legumes growing in the native pastures, of which the commonest are *Glycine tabacina* and *Rhynchosia minima*. These legumes, however, do not form any considerable proportion of the total ground cover.

The carrying capacity varies considerably in accordance with the percentage of better grasses, and may range from one beast to five acres to one to twelve acres. Frequent burning appears to have destroyed many of the finer native grasses.

Sown pastures are limited principally to the scrub soils, and Rhodes grass is practically the only introduced grass found in these areas. Kikuyu grass provides feed on small portions of the more fertile scrub land and is a favoured pasture in pig runs.

Rhodes grass is established either in scrub burns or planted in specially prepared cultivated land. The risk of destruction of the young seedlings by exposure to excessive heat is minimised by planting either in the early summer with a light stand of Sudan grass or in late summer among row crop maize or grain sorghum, just prior to the last cultivation.

A strain of Guinea grass, locally known as green panic, shows promise for the area.

WEED PROBLEMS.

A large range of noxious weeds have been introduced accidentally into the district, often as contamination in uncertified seed. The more troublesome of these include several species of Datura, Noogoora burr (*Xanthium pungens*), Bathurst burr (*Xanthium spinosum*), saffron thistle (*Carthamus lanatus*), star burr (*Acanthospermum hispidum*), wild verbena (*Verbena venosa*), spiny emex (*Emex australis*), galvanised burr (*Bassia birchii*), wild turnip (*Rapistrum rugosum*), wild radish (*Raphanus raphanistrum*), and mint weed (*Salvia reflexa*).

The mint weed has been controlled by Rhodes grass pasture on areas that have not been subjected to overgrazing, but has become a troublesome weed in some cultivation areas.

Urochloa grass (*Urochloa panicoides*) is regarded as a weed in cultivation, particularly in peanuts.

Johnson grass (*Sorghum halepense*) has become established on many properties, though the use of sodium chlorate has been of considerable benefit where infestations were detected early.

An increasing interest is being shown in the control of many weeds by the use of hormone-type weed killers, and interested farmers are purchasing spraying equipment to facilitate the spraying of large areas.

AGRICULTURAL CROPS.

Climatic conditions and soil types in the South Burnett limit the major agricultural cropping programme to the summer months.

Peanuts.

Peanuts (Plates 159-161) rival maize as the most important crop of the area, 95 per cent. of the Queensland crop being planted within a radius of 40 miles of Kingaroy.

Plate 159.

Peanut Crops in the Kingaroy District.

Plate 160.
A Peanut Crop in the Kingaroy District. The bottle tree is a remnant of the original scrub.

Plate 161.
A Field of Recently Stooked Peanuts at Crawford, Showing the Memerambi District in the Background.

The peanut industry commenced with a few small areas in 1919. During 1924 the Peanut Marketing Board was formed and in 1928 the Peanut Growers' Co-operative Association, operating in close association with the Marketing Board, erected a storage and treatment plant in Kingaroy. Droughts and marketing problems resulted in slow growth of the industry for the next ten years and it was not until the early years of the 1939-45 war that a rapid expansion in production occurred. Earlier protective legislation had encouraged the industry and by 1947 the value of the crop was in excess of £1,000,000 from an area of approximately 45,000 acres.

The Peanut Growers' Co-operative Association increased its storage capacity during 1938 and 1948 and though some silos were recently destroyed by fire, large crops can still be handled.

The crop is generally planted on both scrub and forest red loams, though increasing acreages are being planted in the lighter grey and brown sandy to clay loams associated with second-class forest country.

Only two varieties are used—Virginia Bunch and Red Spanish. The higher yield of the former variety results in a larger acreage being planted, though Red Spanish can yield fairly well under some conditions unfavourable to Virginia Bunch. Reduction of plant stand and yield due to crown rot is usually less with the Red Spanish and an increasing percentage of the total acreage is now being devoted to this variety. Yields of Virginia Bunch under favourable conditions may range from 1,500 to 2,000 lb. per acre, with exceptional yields up to 3,000 lb. per acre. Red Spanish yields may range from 1,000 lb., with exceptional yields up to 2,200 lb. per acre. The crop is usually planted during October or November, pulled and stooked during March and April and threshed from April to July.

Recent developments in harvesting have included cutting the mature crop, windrowing with side delivery rakes, sun drying in the windrows and threshing with headers to which pick-up attachments, special peg drums, sieves and elevators are fitted. Advantages of this method are the lower demand for farm labour and the beneficial return of trash to the soil.

Maize.

Maize production in the South Burnett exceeds that of any other district in Queensland and until recent years, maize was the most important crop in the district. The original high fertility of the scrub soils produced, under favourable conditions, yields exceeding 90 bushels per acre, though the district average has been considerably reduced in recent years by lowering of the original soil fertility and by heat waves at tasselling.

Scrub soils in some locations continuously cropped with maize for over forty years are still producing good yields, probably aided by the prolific growth of grass and weeds which develops after cultivation of the maize crop ceases. These weeds, supplemented and sometimes even smothered by the leguminous burr trefoil (*Medicago denticulata*), provide an abundant and valuable source of organic matter.

Although the principal maize areas (Plates 162-164) are associated with the scrub red loams, a large acreage is also planted on the better class forest soils. Grain sorghums, however, are usually more economic on the poorer forest soils.

Plate 162.
A Maize Crop in the Wooroolin District.

Plate 163.
Maize Crops at Crawford.

Until recently, yellow dent varieties, including Improved Yellow Dent, Fitzroy, Leaming and Lady's Finger, were used for approximately 80 per cent. of the crop, the balance being planted with white varieties such as Hickory King, Silvermine and Manning White. Hybrid maize, however, has proved to be superior in yield and in resistance to heat conditions and there is now a strong demand for hybrid maize seed. Yields in excess of 80 bushels per acre are frequently being obtained where the soil and seasonal conditions are satisfactory, and when sufficient seed is available there is little doubt that a large percentage of the district crop will be planted with hybrid maize strains.

Plate 164.
Maize Fields at Corndale.

Planting commences during October, but the most favoured month is December, this later planting being more likely to avoid heat conditions at tasselling than earlier plantings. Highest yields are normally associated with the late November and December plantings.

Mechanical picking machines have been in the district for the past ten years, and during the past three years combined picking and threshing machinery has been favoured. Direct harvesting by means of header-harvesters, though still practised by a few farmers, is not popular and is not likely to increase.

Plate 165.
A Field of Wheatland Grain Sorghum, With Maize in the Background.

Grain Sorghum.

The cultivation of varieties suitable for direct harvesting commenced during 1939. Damage done by parrots on small areas retarded the spread of this crop for a few years, but the yields obtained on soils unfavourable for maize production later encouraged larger acreages. Best results are obtained on the more fertile of the forest soils.

Wheatland (Plate 165) is the most popular variety in the district, accounting for at least 90 per cent. of the acreage planted. Interest is now being shown in Caprock, Martin, and Alpha, and it is anticipated that much of the Wheatland acreage will be taken over by these new varieties.

December planting is generally favoured for two main reasons:—firstly, the sequence of suitable rainfall periods is usually more certain after late November; and, secondly, the grain should mature during the drier months. The average yield is about 35 bushels per acre, with exceptional yields up to 90 bushels.

Navy Beans.

Navy bean production commenced during the second World War and is now well established, particularly in the Kumbia (Plate 166) and Manneum districts. Michelite and Californian Small White are the only two varieties used, the former being the more popular at present.

Plate 166.
Navy Beans in the Kumbia District.

The crop is planted during late December and January and harvested with pick-up threshers during April and May.

Average yields are 12 to 15 bushels to the acre, with the highest recorded yield being 40 bushels per acre. The crop is marketed through the Navy Bean Marketing Board.

Poona Peas.

A large proportion of the Poona pea seed required for green manure crops by the cane industry is grown in the South Burnett. Planted in January, the crops are directly harvested by header-harvesters fitted with rubber concaves in the drum. Yields average about 8 to 12 bushels to the acre.

Sunflowers.

Until recently sunflowers were not grown extensively, but during the 1948-49 season several thousand acres were planted. However, they are not expected to become an important crop in the district on present indications.

Potatoes.

Potatoes are produced under irrigation in the Redgate, Murgon, and Byee districts, with yields from 3 to 8 tons per acre. Factor is the most popular variety for the autumn plant, though a fair proportion of Delaware is planted for the spring crop. Some interest is being shown in the varieties Bismark, Katahdin, Chippewa, and Sebago.

Onions.

Onion growing areas coincide with the main potato producing areas. Brown Spanish is the favoured variety and yields range from 5 to 12 tons per acre.

Lucerne.

The area planted with lucerne is not high and is principally associated with the alluvial flats adjacent to the main creeks (Plate 167). High yields of excellent quality lucerne are produced on the Boonara flats near Goomeri and at Redgate and Byee near Murgon. The scrub red loams can produce good crops and a larger acreage could be planted with advantage on this type of soil.

Plate 167.

Mowing a Lucerne Crop in the Kingaroy District.

Winter Crops.

Linseed growing is becoming of more importance in the district, and over a thousand acres were planted during 1950.

Wheat production is not extensive, but satisfactory yields of good quality grain are produced. The acreage available for this type of crop is not large enough for it to become of particular importance.

Oats are popular for grazing in the winter months and a small acreage of barley for grain is also grown.

CERTIFIED SEED.

South Burnett farmers have for many years been interested in the availability of good quality seed. Seed certification has thus met with a ready response from both seed producers and seed purchasers.

The aim of the seed certification scheme is to supervise the production of seed of crop varieties which will be true to type, free from contamination with other varieties or with weed seeds, free from seed-borne diseases, and of a high standard of germinability. The varieties chosen for seed certification are those which are well adapted and capable of high yields either in this or in neighbouring districts.

A wide range of sorghum varieties and Queensland maize hybrids is now produced and marketed annually within the district's boundaries. Under the control of the Seed Certification Committee of the Queensland Department of Agriculture and Stock, areas for the production of seeds of the following varieties were planted during the 1949-50 season:—

Hybrid Maize: Q23, Q431, Q629, Q692, Q739, Q658.
Grain Sorghum: Wheatland, Early Kalo.
Sweet Sorghum: Italian, Sugardrip, Honey.
Sudan Grass: Roma.
Beans: Brown Beauty.

HORTICULTURAL CROPS.

Horticultural crops are of practically no commercial importance in the district and are confined to small farm orchards, generally for private use only. However, excellent oranges and mandarins are produced on the rain forest areas and most vegetables can be readily grown throughout the district,

FORESTRY.

Valuable forestry reserves and re-afforestation areas are concentrated in the southern and eastern fringes of the district, including portions of the Bunya, Cooyar, Blackbutt, Brisbane and Coast Ranges.

State forest reserves include 172,677 acres, timber reserves 28,539 acres, and national park reserves 9,605 acres. Approximately 13,000 acres of forest reserves have been replanted with hoop pine (*Araucaria cunninghamii*), *Pinus patula*, and *Pinus caribaea*. Some flooded gum and ironbark are also included. Five nurseries provide the young trees for the annually increasing re-afforestation areas.

DAIRYING AND PIG PRODUCTION.

The majority of farmers in the South Burnett combine dairying with the production of crops, and approximately one-seventh of the Queensland butter yield is produced in this district.

The size of properties varies from 160 to 320 acres in the closely settled portions of the district and from 320 to over 1,000 acres in the more outlying areas such as Durong. While pastures of natural grasses and Rhodes grass are of importance, most farmers depend principally on fodder crops.

Many thousands of acres of Sudan grass (Plate 168) are planted each year, and although the risk of poisoning cattle is well known in the district, the crop is grazed in all stages and under a wide range of seasonal conditions with very few losses. The risk of the introduction of Johnson grass in Sudan grass seed is of great importance and for this reason the supply of certified seed has been welcomed.

Plate 168.

A Dairy Herd Grazing on Sudan Grass at Corndale. The slopes in the background are under maize.

Winter and spring feed is provided from two sources, namely, crop residues, including peanut trash, and oats for grazing. The most important oat varieties planted are Victoria x Richland and Algerian, but increased acreages of Klein will be planted when seed supplies are more readily available. Until recently the readily available supplies of peanut trash made the storage of summer crops in the form of ensilage of minor importance. However, increased interest is now being shown in silos, particularly by stud breeders.

Both Jersey and A.I.S. breeds are well represented in the pure herds of the district, with many Queensland champions being produced by local breeders. Probably 60 per cent. of the dairy cows in the district are of the A.I.S. breed. The majority of the smaller herds are Jersey. The bulk of milk produced in the district is used for butter-making, and an indication of the output can be gained from the production figures for 1949-50:—

Factory.	Butter Production. lb.
Kingaroy	4,141,635
Nanango	2,935,155
Wondai	2,865,808
Murgon	2,761,250
Proston	1,548,000

Cheese production is carried on in two factories, while the Murgon factory produces pasteurised milk for distribution over the whole of the South Burnett.

Pig raising is of considerable importance in the district, and more than 100,000 pigs are railed each year to Brisbane and Toowoomba. Stud piggeries representing Tamworth, Canadian Berkshires, and Large Whites produce high-class pigs, but the majority of farmers rely on crossbred sows with purebred boars.

THE GRAZING INDUSTRY.

Beef cattle production is an important industry in the district. There are a number of stud herds, mostly Hereford, but including Aberdeen Angus, Shorthorn, and Polled Herefords. However, probably 90 per cent. of the holdings are used for fattening, breeding being of lesser importance.

The size of the holdings varies from 2,000 to 15,000 acres. The majority are completely dependent on native pastures, though some holdings contain a fair percentage of Rhodes grass. Stud properties usually supplement their pastures by green feed on cultivated areas.

Many farmers who concentrate on the production of peanuts, maize, and grain sorghum, without dairying, purchase stores and fatten them on crop residues and grass paddocks. This practice is to be commended, as the increased farm income will usually be associated with an improved cropping sequence resulting in better maintenance of soil fertility.

Root Crop Vegetables.

C. N. MORGAN, Senior Adviser in Horticulture.

THE carrot, beetroot, parsnip, turnip, swede turnip, radish, and salsify, although representative of four quite distinct plant families, have very similar cultural requirements. It is therefore usual for the specialist grower to handle two or more of these plants in his cropping programme each year. Some are grown extensively on a commercial scale, but others such as radish and salsify are better adapted to the home garden.

CARROT.

The carrot (*Daucus carota*) is said to have originated in Europe and Asia, but much of its early development from the wild state to the cultivated vegetable of to-day took place in France. The crop has increased in importance and popularity over the last few years and is now rated highly because of its vitamin A content.

Cool conditions are required for carrot growing but good crops are harvested during most of the year in some part or other of Queensland. In the far north the carrot is essentially a winter crop, in south-eastern Queensland the growing season extends from early autumn to late spring, and in the temperate climate of the Granite Belt the crop is grown during the summer months.

Soils and Preparation.

Carrots do well on most soil types providing the drainage is good, and payable crops have been grown on heavy, medium and sandy loams. Ground which sets hard after rain is not suitable as growth is restricted and the roots may be misshapen. Preference should be given to a sandy loam.

Thorough soil preparation is particularly desirable for carrots, which must be planted on finely prepared ground where the roots can penetrate deeply and quickly through the soil, as even a slight check is harmful.

When the crop is grown on raised beds, the land should be ploughed to a depth of not less than 8 inches, but a 10-inch ploughing is needed if the crop is to be grown without hilling. It is not difficult to prepare a light sandy loam for the crop, but at least two ploughings are necessary on the heavier soils. Harrowing or discing between ploughings, followed by further working, brings the soil into seed-bed condition prior to planting.

Fertilizers and Manures.

On well-prepared and well-manured land (Plate 169) the carrot crop requires little feeding. At the addition of fresh manure to the soil just prior to planting may produce badly forked roots, carrots should preferably follow a well-manured crop. In this case, the carrots are topdressed when they reach the thinning stage approximately four weeks after seeding. A suitable topdressing is a 5–14–5 water-soluble fertilizer at 2 cwt. per acre.

In less fertile soils, a basal dressing of fertilizer is spread along the furrow in the crop row or broadcast over the whole area at least two weeks before sowing. Broadcasting is usual where the plants are grown on hills, as the fertilizer is worked into the soil when the hills are made. A fertilizer containing approximately 5 per cent. nitrogen, 13 per cent. phosphoric acid and 5 per cent. potash is satisfactory on most soils. If applied as a basal dressing the mixture should contain a fair proportion of blood and bone. The water-soluble form of the same mixture is preferred as a topdressing. Form 8 to 10 cwt. per acre, or 3 to 4 oz. to the square yard, should be sufficient for the crop.

Plate 169.

A Typical Cover Crop in the Redlands District. Such crops should be ploughed in early so that the green matter can rot down before the root crop is sown.

Planting.

On shallow soils, the crop is planted on hills or raised beds four to five inches high and with a 20-24-inch wide flat surface. The distance between the centres of the hills is from 3 feet to 3½ feet if horse implements are used for cultivation, but may be much less where only hand tools are available. On the prepared hills, double rows are planted 12 inches apart. On flat sandy loams hilling is not necessary and the crop may be planted either in double or single rows. The double rows should be about one foot apart with three feet centres between adjacent pairs; single rows may be closer according to the implements in use. In the home and market garden, rows may be planted from nine to 12 inches apart.

Small hand-operated planters may be used for carrots, the seed being sown at the rate of about 4 lb. per acre at a depth of ½ to ¾ inch. The soil must be firm, level, free from dead grass or weeds and in good tilth if the planter is to work efficiently. For small plantings, a ½ to ¾ inch drill may be made with the hoe or rake handle, the seed dropped along it and the ground levelled. About ¼ oz. of seed is sufficient for 100 feet of drill. After planting, the ground must be well firmed. The rear wheel on the hand planter usually does this job reasonably well, but even so the hills should be lightly rolled after planting.

If possible, the ground should be irrigated immediately after planting and kept moist until the seed has germinated. Germination usually takes nine to 14 days. The crop is difficult to establish when the weather is hot and it is then advisable to increase the seeding rate to 5 lb. per acre. The small grower will find light shade an advantage for February-March plantings. The covering may be removed altogether after the second fern leaves are showing.

Cultivation.

Cultivation of the beds should start early, the beds being watered a week or two before seeding to encourage weed growth, which is then lightly hoed off. Weeding between the rows is comparatively easy; a flat hoe is a good implement. All cultivation must be shallow. A certain amount of hand weeding is unavoidable, but if the soil preparation has been good, little weeding should be necessary before thinning, when the two operations may be carried out conjointly. Weed control in the young crop can be achieved with a kerosene weedicide which, when used correctly, kills most weeds but does not hurt the young carrots. Treatment is, however, a specialised job requiring a great deal of care. Little cultivation will be necessary on the hills or near the rows after the first thorough weeding, as the tops rapidly shade and smother any new weed growth.

Over-crowding is undesirable and commercial growers thin carrots to about three inches between plants a month or so after planting. The home gardener may thin out gradually as the plants are growing and use the young roots as required. Thinning is done by hand when the soil is moist and the roots leave the soil quickly and freely.

Irrigation assists germination and is desirable when the plants are young and subject to the effect of heat. Irrigation must be thorough so that the water penetrates to the bottom of the root zone. When the carrots have reached maturity and are to be held in the soil, only sufficient water should be used to keep the plants bright and tender.

Harvesting and Marketing.

Small market gardens sell bunched roots from about 1 inch to 1¼ inches in diameter (Plate 170), but the commercial grower usually leaves the crop in the ground until the roots reach their full size about 3½ to 4½ months after planting. Large carrots in good condition (Plate 171) meet a ready market and when sold by weight give the greatest return per acre. The roots are harvested each week by hand and it is usual to go through the crop selecting only the larger carrots. The remainder continue to grow until they are removed at one or other of the harvesting periods.

In sandy loams, "pulling" is comparatively easy and causes no damage to the roots, but in heavier soils it may be necessary to first loosen the ground with a digging fork. For marketing in bunches, the

roots are washed, graded for size and tied in bunches of a dozen with the tops on. When marketed in bags, the tops are cut off about an inch above the crown.

Varieties.

Carrot varieties may be classified as follows:—

(*a*) Long rooted varieties, such as Intermediate and St. Valery.

(*b*) Half long varieties, such as Red-cored Chantenay, Chantenay, Danver's Half Long, Manchester Table, and Osborne Park.

Plate 170.

Carrot Varieties: Chantenay (left) and Danvers (right). Both are half-long types grown for the bunch trade.

The Red-cored Chantenay is by far the most popular commercial variety and Danver's Half Long is next; both are an attractive colour and their strong leaves make them suitable for the bunched trade.

(c) Stump rooted varieties, such as Ox-heart (Guerande) and Early Horn.

The variety Early Horn is suitable for the home garden, being quick maturing with an attractive colour; it is perhaps the best for shallow soils.

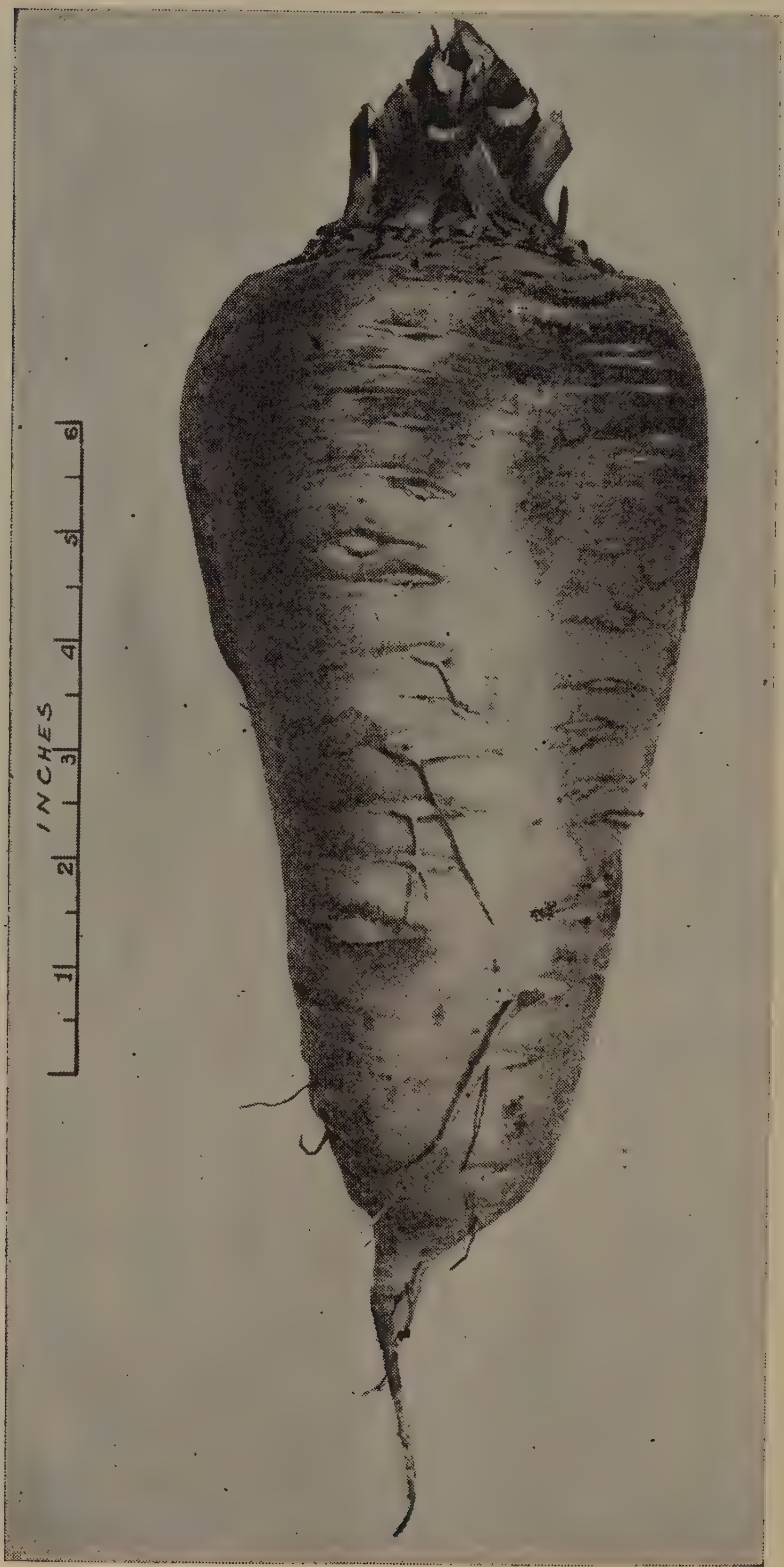


Plate 171.

Chantenay Carrot at the Stage of Harvesting for the Bagged Trade.

BEETROOT.

The beetroot (*Beta vulgaris*) originated in Europe and has been developed from an original long-rooted ancestor to the popular globe types of the present day.

The plant thrives under cool conditions and is grown successfully from North Queensland to the New South Wales border. In the coastal areas of south-eastern Queensland where the climate is fairly equable good marketable crops are grown under irrigation throughout the year, with the exception of the hot summer months.

Soil Preparation.

In common with most other root crops, the beet prefers a loose loamy soil which is fairly deep and well drained. It does particularly well in sandy loams. However, providing land preparation is thorough, the crop can be grown on many other soil types. Heavy clay loams which set hard after rain or irrigation are the least suitable.

Land preparation should ensure a depth of eight to 10 inches of loose friable soil for the crop. Early preparation is desirable so that weeds can be controlled before planting. The heavier loams are usually hilled to promote rapid root-penetration and quick growth. A fine tilth assists seeding.

Fertilizers.

Beets do best following a well-manured crop. The use of fresh manure is undesirable but a well-balanced fertilizer is required on most soils.

The fertilizer may be applied during the final stages of soil preparation or as a topdressing three or four weeks after planting. On a soil of low fertility, it is as well to apply the fertilizer prior to seeding. A fertilizer containing roughly 5 per cent, nitrogen, 13 per cent. phosphoric acid and 5 per cent. potash is sufficiently well balanced for beet requirements in Queensland soils, and 7 to 10 cwt. per acre should be ample for the crop. If applied as a basal dressing, the mixture may contain a fair proportion of blood and bone, but if used as a topdressing, it should be in a water-soluble form. If the beet is planted in single rows, the topdressing is applied in a band along the side of the row and about three to four inches from the plants. With double rows on hills, the fertilizer may be distributed in the double row. Where irrigation is available, it is unnecessary to work a topdressing into the ground, as watering takes the fertilizer down to the roots.

It may be necessary on some soils to apply a small amount of borax to correct deficiency troubles such as girdling and multiple crowns (Plate 172).

Planting.

In most commercial beet areas, the seed is planted in the field, by either hand or planting machine. On light sandy loams, the seed is sown on the flat in single rows 2 to 2½ feet apart, depending on the types of implements available and the method of cultivation used. On the heavier ground, the crop is sown in double rows approximately 12 inches apart on hills, with 3½ feet between the centres of the hills. Single-row planting is preferred for rain-grown crops, but with irrigation the closer double row plantings are the best. Four to six pounds of seed should be sufficient to plant an acre. Owing to the relatively large size of the seed, planting may be done easily by hand; a machine planter works well only with graded seed.

Planting should be shallow—from ½ to ¾ inch—at least in irrigated crops. On non-irrigated soils, the seed may be planted slightly deeper. Germination may be erratic unless the seed is sown under very favourable conditions. Uneven germination can be overcome, to a certain extent, by soaking the seed overnight in water prior to planting.

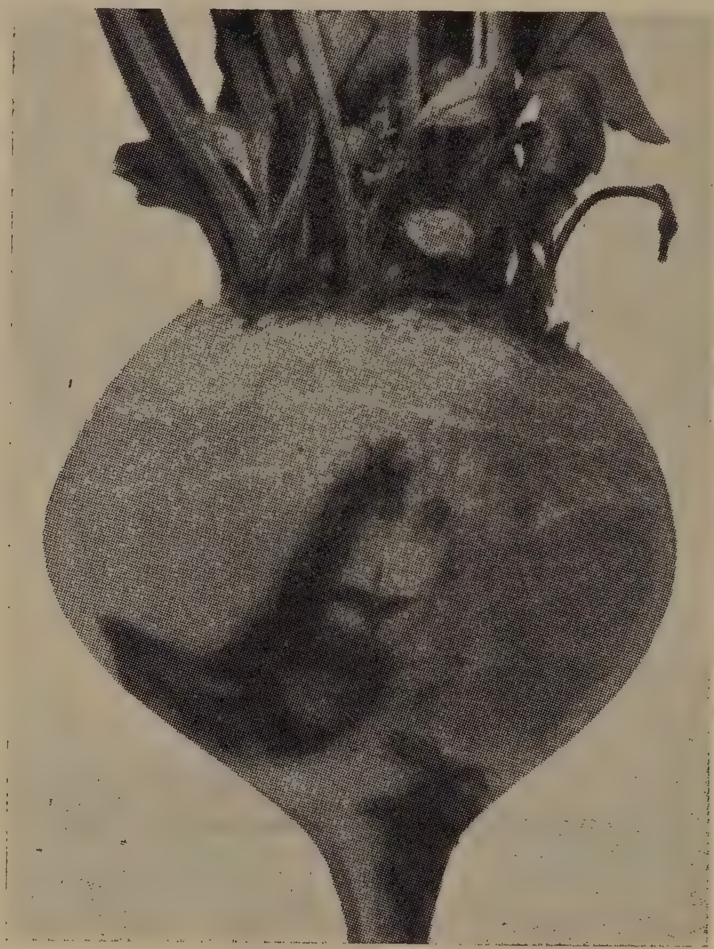


Plate 172.

Girdling and Multiple Crown on Beetroot. These are symptoms of boron deficiency.

Cultivation.

When the beet plants are about two to three inches high, they are thinned to single plants three to four inches apart. Failure to thin results in numerous small and often malformed roots. Any misses in the row may be filled in with plants taken out at thinning.

Following adequate soil preparation and early weed control, little cultivation should be necessary. The first cultivation often coincides with thinning, and if the plants are growing rapidly, no further treatment is required. Shallow-working implements are essential, and a small hand cultivator with attachments such as a flat hoe which does not dig deeply into the soil, is suitable. Between hills or wide rows, horse or machine cultivation is practicable.

Irrigation ensures an even strike and the production of high-quality beet which are characteristic of a quickly-grown crop. Any cessation of growth makes the roots fibrous and unattractive. The soil should be kept moist to plough depth and an irrigation before harvesting makes "pulling" easy.

Marketing.

In the warm autumn and spring months, some beet should be ready to harvest about eight weeks after planting (Plate 173). Regular "pulling" during the next few weeks is necessary, for beet left in the field rapidly increase in size and become too large for the market. During the winter months, harvesting may be prolonged to some extent without marked deterioration in quality. The first beet are usually ready for harvest in 10 to 11 weeks at this time of the year. Root sizes ranging from 2½ to 3 inches in diameter suit the Queensland market; large beet are not popular as they are often coarse and unattractive.

Plate 173.

Early Wonder Beet at the Stage of Harvesting for the Bunch Trade.

Beet are sold chiefly in bunches of a dozen with tops on. Immediately after harvesting they should be washed, the dead and discoloured leaves removed, and the beet bunched and stacked under shade. Wilting of the tops occurs quickly when beet are exposed to the sun. The tops are removed about an inch above the crown if the roots are sold in bags.

Varieties.

Of the numerous varieties available, the following are suitable for Queensland conditions:—

Early Wonder or Rapid Red.—Quick maturing, globe shaped, fairly free from zoning during most of the year (Plate 174); has a large top which makes it attractive for the bunch trade; colour is deep red.

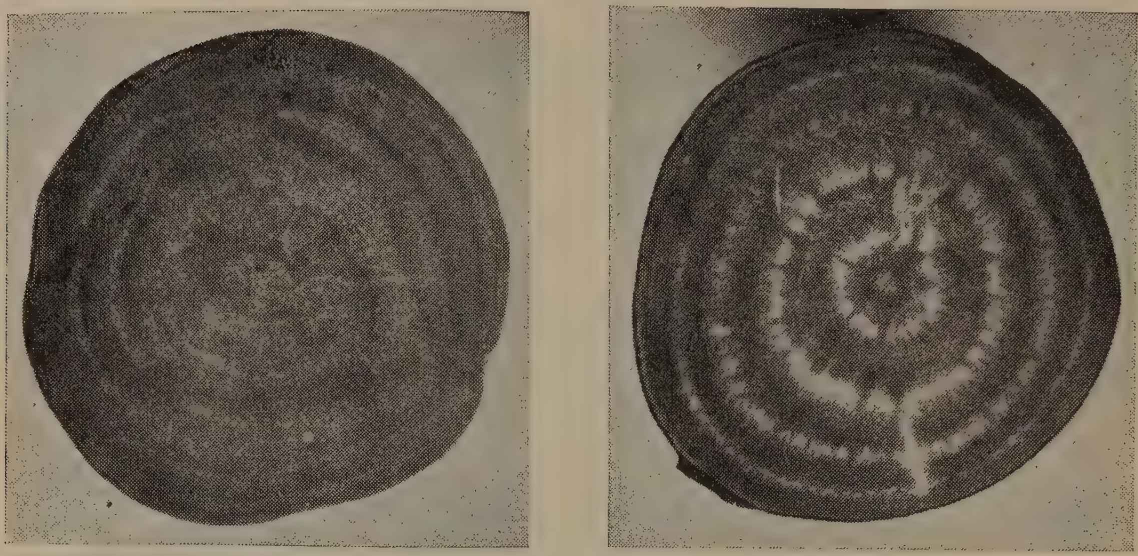


Plate 174.

Zoning in Beet. Cross section of a normal beet (left) and a beet with typical zoning. Zoning is a defect in some varieties at certain times of the year.

Derwent Globe.—Probably more free from zoning than Early Wonder; colour is dark red; suitable for bunch trade.

Crimson Globe.—Early maturing; colour is deep red.

Detroit Dark Red.—An attractive beet, extremely dark red in colour; tops are small and the crop is usually bagged.

Egyptian Turnip Rooted.—Extra early; flat shape; suitable for home gardens.

Obelisk.—Cylindrical shape, deep red and of good flavour; suitable for home gardens.

PARSNIP.

The parsnip (*Pastinaca sativa*) is a cool weather crop which came from the Mediterranean area. It has a distinctive flavour which limits the demand to a small but appreciative number of consumers. Although it is one of the hardest of the root crops to grow, the market could easily be over-supplied by a small increase in the present acreage. The crop is less tolerant of heat in the early stages than carrots.

The parsnip is grown mainly on deep sandy loams, which are more easily prepared for this crop than the red volcanic loams. The long tender roots of the parsnip cannot stand any check in their downward movement and fork badly under adverse soil conditions. Soil preparation and fertilizer practice follow closely those recommended for carrots and the greatest care must be taken to obtain a deep friable seed-bed.

Planting.

If the ground is fairly shallow the seed should be planted on hills similar to those required for carrots. Only fresh seed should be used, as germination is frequently low in batches more than one year old.

The soil should be firmed and the seed sown rather thickly to a depth of about $\frac{3}{4}$ inch. Immediately after seeding the soil should be rolled or tamped firmly. Five to six pounds of seed is required to plant an acre, or approximately $\frac{1}{2}$ oz. to every 100 feet of row. Distances between rows are the same as for carrots. March to May is the main planting period on the coast but early spring is the best for the cooler tablelands.

Cultivation.

Cultural methods applied to carrot crops are suitable for parsnips but thinning may be delayed as much as five weeks. It is inadvisable to thin out to more than four inches as the crop grows slowly and after the first harvest the roots left in the field will increase in size. There is little demand for large thick roots and wide thinning tends to encourage this condition.

Seed of the parsnip is slow to germinate and the plants may not come through ground with a hard crust on top. Early irrigation is therefore required to keep the ground moist enough for germination and loose enough for the small plants to push through. Subsequently, sufficient water should be applied to reach well down into the soil.

Harvesting and Marketing.

Parsnips are harvested and marketed in the same manner as beet or carrots, but the first pick does not take place until 4½ to 6 months after planting. Care is required in lifting the long roots, and unless the ground is a free moist sandy loam the use of a digging fork is necessary.

Varieties.

Good varieties are not plentiful. The most popular is Hollow Crown.

TURNIP.

The turnip (*Brassica rapa*) is a cool season crop which may be grown on practically all types of soils. It is much hardier and more rapid in its growth than the carrot or beet and soil preparation need not be so thorough. The plant thrives in any reasonably fertile soil, and does particularly well following another heavily manured crop. Should fertilizer be considered necessary, a dressing of from 3 to 4 cwt. per acre, or approximately 2 oz. to the square yard, of a 5–13–5 fertilizer should be sufficient. Borax may sometimes be necessary to correct boron deficiency, which results in multiple crowns and other undesirable features.

Planting.

Seed may be planted in drills and it is rarely necessary to go to the trouble of hilling. Single or double rows may be used, with distances similar to those recommended for beetroot. Two pounds of seed should be sufficient to plant an acre, or about ¼ oz. for 200 feet of drill. Plantings may be made from March to August on the coast and in spring on the tableland areas.

Cultivation.

The turnip germinates within a few days, grows rapidly and tends to smother many of the weeds in the rows. Some hand weeding will be necessary as well as cultivation between the rows. The crop is thinned a few weeks after germination to a spacing of from two to three inches between plants.

Harvesting and Marketing.

Turnips should be ready for harvesting in from eight to 10 weeks after sowing. The roots are pulled and sold in bundles of a dozen. Harvesting from one planting may continue for a few weeks but the turnips develop a strong objectionable flavour as they reach maturity and therefore should not be allowed to grow too big.

Varieties.

Purple Top White Globe.—A white globe turnip with an attractively coloured purple top; has strong foliage suitable for bunching.

White Stone.—A white, round turnip of good quality.

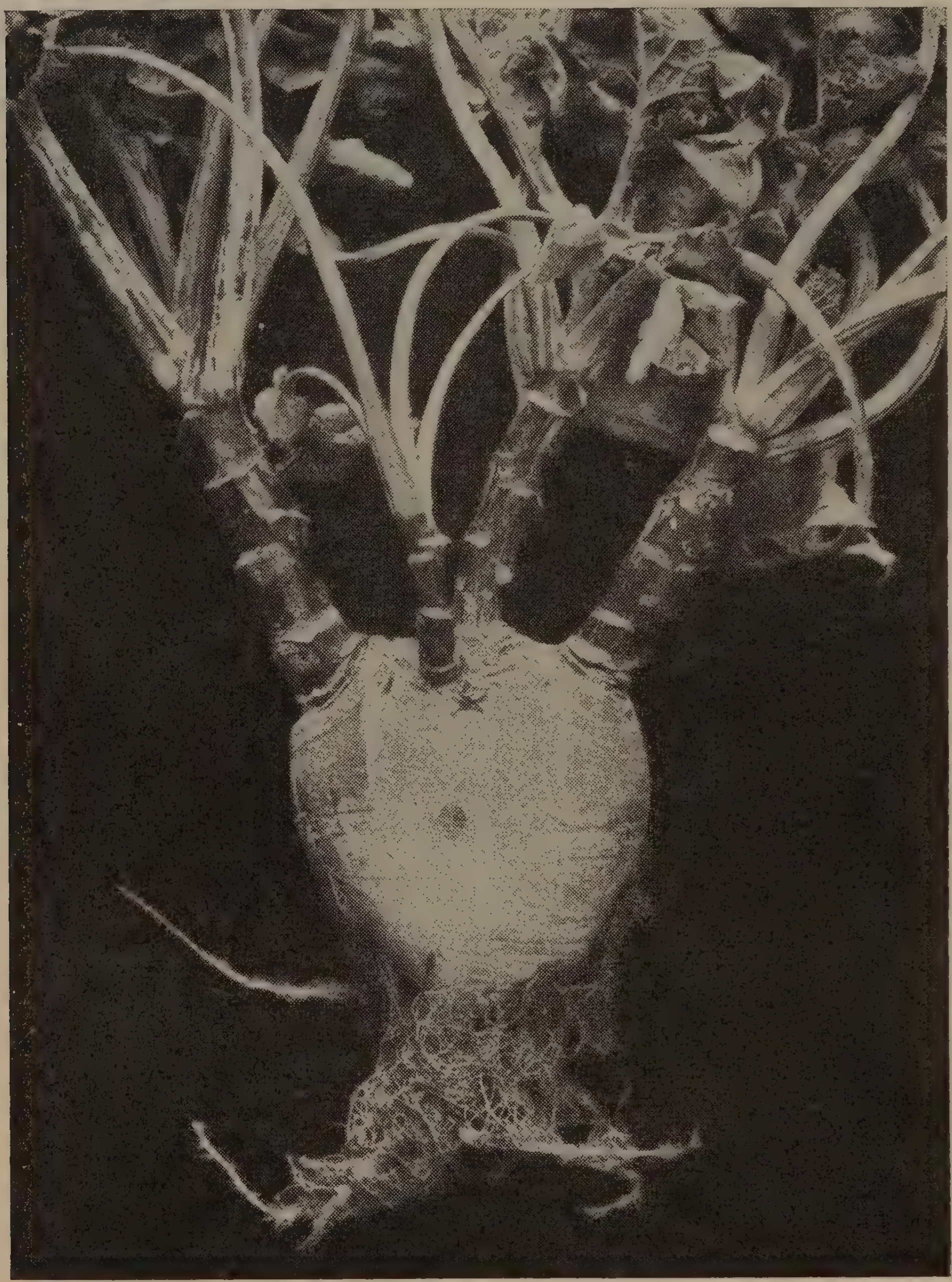


Plate 175.

Multiple Crowns on White Turnip, a Symptom of Boron Deficiency.

SWEDE TURNIP.

The Swede turnip (*Brassica napobrassica*) is grown mainly in agricultural rather than horticultural districts. It is a robust type of root crop which is adaptable to most soil types. Being less tolerant of heat than the ordinary white turnip, late plantings which carry the maturing crop into the hot weather should be avoided. Cultural conditions for the Swede turnip follow closely those applied to ordinary turnips but it may be necessary to thin out to at least five inches, as the roots are larger when mature.

The crop takes much longer to grow than the white turnip and in cold areas where frost is prevalent may occupy the ground for a period of four to five months. However, the roots should be fit for use much earlier where the weather is not so cold.

Bunching for market is satisfactory with reasonably small roots; the larger ones are topped and sold in bags. Old roots should not be harvested owing to their objectionable flavour.

Varieties.

The main variety is Purple Top, which is yellow fleshed, globe shaped and early maturing.

RADISH.

The radish (*Raphanus sativus*) is an easy vegetable to grow in its right season.

All types of soil appear to grow radishes well. Normal soil preparation to spade depth, which leaves the ground in a reasonable tilth, should be sufficient.

Fresh manure should not be used immediately before planting. Well-rotted manures, compost and any complete garden fertilizer with a fair amount of blood and bone are satisfactory. Unless they are grown quickly, radishes rapidly develop a strong flavour.

Planting.

Being hardy, the radish may be planted at almost any time of the year except during the hottest months. Seed should be sown fairly thickly in shallow drills about half an inch deep and about nine inches apart. About ½ oz. of seed is sufficient for every 100 feet of drill. Germination occurs in three to seven days according to weather conditions. It may be necessary to thin the seedlings to about 1½ inches apart.

The plants should be kept growing quickly by regular watering, and harvesting usually commences three to four weeks after seeding.

Varieties.

There are numerous varieties, but the following types grown in Queensland are the early maturing sorts:—

French Breakfast.—An oval-shaped radish, red in colour with a white tip.

White Icicle.—A long tender variety, mildly flavoured and pure white in colour.

Long Scarlet.—Five to six inches in length, good flavour.

SALSIFY.

Salsify (*Tragopogon porrifolius*), a native of southern Europe, is not grown to the extent that its quality deserves. The white salsify is commonly known as the vegetable oyster because the flavour of the cooked vegetable has some resemblance to oysters.

The root is somewhat similar to but smaller than that of the parsnip. General soil preparation and planting may be done in the same way. The salsify has a longer growing season than the parsnip and should be planted to avoid maturing in the hot weather.

The main variety is Sandwich Island.

The Cleansing of Milking Machines.

THE DILUTE CAUSTIC SODA SOLUTION METHOD.

THE successful operation of a milking machine depends on the care and time given to it. Any neglect in keeping it clean will be reflected in the quality of the milk or cream supplied to the factory. The boiling water and caustic soda method has proved efficient for the cleansing of the milking machine, and in order that the method may be simply yet thoroughly applied the following are essentials:—

(1) An adequate supply of pure water.

(2) A steam sterilizer for boiling water and providing steam.

(3) Caustic soda. (Approved proprietary cleansers may be used in place of caustic soda.)

(4) A complete set of brushes for cleaning all parts of the machine.

To simplify this method, a routine system should be adopted, and the following has been found satisfactory in actual practice:—

Treatment Before Use.

Just before milking, give the machine (and all utensils) a cold water rinse to which a chlorine compound (used in accordance with instructions on the label) has been added (chlorine is not a cleanser, but a germicide). The used chlorine solution may be retained for washing udders, also floors, and for similar purposes.

Treatment After Use.

Milk System.

1. Immediately after each milking wash all dirt from the exterior of the rubbers and teat cups, using a vessel and brush kept exclusively for this purpose.

2. Draw 1 gallon of cold water through each set of teat cups; while doing this, withdraw the cups from the water several times, thereby causing a surging effect which flushes the pipes and rubbers more thoroughly, and ensures more effective removal of milk residues than a steady flow. Always start on the set of teat cups farthest away from, and work towards, the releaser.

3. Draw through each set of teat cups at least 1 gallon of hot dilute caustic soda solution, which is made by dissolving 1 level dessertspoonful of caustic soda in 4 gallons of hot water. (Proprietary cleansers may be used instead of caustic soda, and, if so, use them according to the instructions on the label of the package.) While drawing the hot caustic soda solution through the teat cups nearest the releaser, the torpedo brush supplied with the machine or a ball of horsehair is run through the milk pipe. The vacuum will carry this through with sufficient momentum to remove traces of milk from the interior of the pipe. If a torpedo brush is used the attached cord should be just long enough to enable the brush to travel the full length of the milk line, but not so long as to allow it to hit against and damage the metal of the releaser. Retain the caustic soda solution for using on the air line.

4. Next flush the whole of the milk system with clean, *boiling* water, using at least one gallon (preferably two) per unit, in order to remove all traces of the soda solution. This is important, for if the caustic soda solution is not rinsed off with plain water the tinning will gradually be removed from the milk pipes.

5. After this has been done, sterilize the entire milk system with steam, but it should always be remembered that the efficiency of steam sterilization depends on the effectiveness of the prior cleansing operations. If steam is applied to the machine before thorough cleansing, the heat will bake the milk remnants on to the interior of the pipes. This residue forms a hard deposit, known as milkstone, which makes cleansing and near sterilization difficult.

Air System.

Cleanse the air line at least once daily by flushing with hot soda solution, followed by clean, hot water. (The soda solution and hot water previously used for the milk lines may be used.) Because of the differences in the way of cleaning the airline of different machines, the manufacturer's instructions should be carefully followed. In the event of a farmer not knowing how to clean the airline of his machine, he is advised to contact the manufacturer or the local Dairy Officer.

Note: It is important to thoroughly cleanse at each milking the rubber tube between the outer chamber of the releaser and the releaser pulsator.

Sundries.

After all operations have been completed, dismantle the releaser, thoroughly cleanse, and sterilize with steam. Then remove the vacuum tank, cleanse, sterilize, and store both it and the releaser in some dust-free position.

Take the teat cup assembly and long rubbers off the down drops, and hang in a cool place. Remove all rubber plugs, or throw open flaps.

After each milking, remove the glass observation bowls and rubber washers under them and place in a position to dry.

Weekly Dismantling of Machine.

At least once a week completely dismantle and clean the machine. Take down the observation bowls, rubber washers, teat cups, claws, air and milk droppers and top rubbers; in fact, every part of the plant that will come asunder, and thoroughly wash inside and out with hot soda solution, then boiling water, and finally sterilize with steam.

At least once a week place all rubberware in a clean hessian bag, suspend in water to which has been added one level tablespoonful of caustic soda for each 4 gallons, and boil for ten minutes. This prolongs the life of rubberware.

Summary.

Summarised, the procedure in the cleaning of machines by the dilute caustic soda solution method is:

(1) Just before each milking flush the milk system with clean, cold water containing a chlorine compound in the proportion indicated by the manufacturer.

(2) After use, rinse each unit with at least 1 gallon of cold water.

(3) Run through the milk system a hot, dilute caustic soda solution (1 level dessertspoonful of caustic soda to 4 gallons of hot water), using 1 gallon of the solution to each set of teat cups.

(4) Run plain *boiling* water through each set of teat cups, using at least 1 gallon (preferably 2) of boiling water for each unit.

(5) Sterilize the milk system with steam.

(6) Once daily thoroughly cleanse the air lines.

(7) Remove and dismantle the releaser and vacuum tank, wash each thoroughly, sterilize with steam and store in a dust-free place.

(8) Disconnect teat cups and all rubbers. Open up all flaps or remove rubber plugs on the machine.

(9) At least once a week completely dismantle the machine and thoroughly cleanse and sterilize it.

THE BUSH BOOK CLUB.

Country people who live beyond the reach of libraries are invited by the Queensland Bush Book Club to take advantage of the service offered by the Club in providing reading matter on loan.

A small annual membership fee is charged, but carriage on parcels to the nearest railway station is free.

Books are sent in parcels of ten, together with magazines. These last the average reader about three months, but faster readers may obtain more than four lots a year if desired.

In addition to general reading, the Club will provide information on such subjects as simple dressmaking and domestic science.

The Club's library is provided by Brisbane people and other well-wishers, and the Club's activities are a tribute of friendship to the people of the country from the women of the city.

To join the Club just write to the Queensland Bush Book Club, Victory Chambers, Adelaide street, Brisbane, or, if you live in the North, to Queensland Bush Book Club, Kellock's Building, Townsville.

The Sheep Blowfly Problem in Queensland.

3. The Attractiveness of Sheep to Blowflies.

4. Seasonal Conditions in Relation to Blowfly Strike.

G. R. MOULE, Director of Sheep Husbandry.

3. The Attractiveness of Sheep to Blowflies.

BLOWFLY strike in sheep is characterised by the development of maggots on or under the skin. As the result of their presence the skin becomes inflamed and bloodstained fluid may exude through the damaged parts. The presence of maggots on or under the skin can be very irritating and affected sheep may bite at the struck area. Later they may become fevered and extremely sick and may die.

The word "strike" connotes these changes. It includes the deposition of the eggs by adult flies, the hatching and development of the maggots, and the feverish reaction shown so commonly by struck sheep.

In most cases sheep are not struck by chance. It is well known that some animals suffer frequent strikes, while others remain unaffected during severe waves. This is because of differences in the attractiveness of some sheep to blowfly strike, and it is important to understand their nature.

FACTORS WHICH INFLUENCE ATTRACTIVENESS TO BLOWFLIES.

When considering the attractiveness of sheep to blowflies two things have to be examined:—

(1) The conditions which *predispose* sheep to strike.

(2) The conditions which render sheep *susceptible* to strike.

Sheep which are predisposed to strike will only be struck provided they become susceptible to strike. Sheep which are not predisposed to strike do not, in most circumstances, become susceptible.

Conditions which Predispose Sheep to Strike.

(a) The General Attractiveness of Sheep to Blowflies.

It has been shown that most of the common species of blowflies are more or less attracted to and feed on soiled or wet fleece. In addition, the green blowfly (*Lucilia cuprina*) lays its eggs more readily on wet fleece than other species of flies. This general association between flies and sheep greatly increases the chances of strike and it is probably due to some particular smell associated with the tip of the wool. During investigations in New Zealand, it was found that blowflies were attracted mainly to the tip of the staple rather than the base, although no unusual differences could be observed between the two ends.

(b) The Conformation of the Sheep.

The conformation of the sheep can influence the development of areas which are highly attractive to blowflies and susceptible to strike. This is likely to be of importance in relation to crutch strike, tail strike and body strike. Considerable variation occurs in the size and shape of the bare area surrounding the vulva and anus. If this is small, the wool is readily soiled with urine and droppings and soon becomes attractive to flies.

Crutch Strike.—It is well known that wrinkly breeched sheep suffer more frequently from crutch strike than sheep which are plain breeched. An example of this is presented in the following table, which was compiled from observations made amongst a group of 73 Merino ewes which were kept under observation for three years.

BREECH STRIKES: AGED EWES, 1933–36.

Type of Breech.	Number.	Number. Struck.	Percentage Struck.	Number of Strikes.	Average Percentage of Strikes Per Annum.
Plain	23	10	43	24	35
Moderately wrinkly ..	35	31	89	132	126
Very wrinkly	15	15	100	105	233
Total	73	56	77	261	119

Tail Strike.—More recently it has been shown that the length and the method of cutting off the tail can predispose to, or protect sheep from, strike originating on the tail or crutch. For these reasons the tailing operation is of considerable importance.

If the tails are cut so that the bare skin from the under-surface is turned back over the severed stump, the sheep is not so likely to be affected by strike as it is if the tail is cut in a way which permits the wool-bearing skin to be drawn down to form a "woolly mop" on the end of the tail. This is likely to become soiled with urine and/or faeces, and in this way it can lead to the development of susceptibility to strike.

The length at which the tail is cut also influences predisposition to both crutch and tail strike. If the tails are too short or too long the sheep are likely to suffer from increased crutch and/or tail strike. The most suitable length at which to cut lambs' tails appears to be level with the tip of the vulva. Tails cut at this length grow proportionately

with the rest of the animal's body and confer a marked degree of protection from strike, as the following figures of degree of strike and tail length show:—

—	Covering Vulva.	Medium.	Short.
Number of sheep	74	69	81
Number of breech strikes	9	15	20
Number of breech and tail strikes	Nil	5	8
Number of tail strikes	1	2	7

More recently it has been observed that the amount of wool-growing skin on the top of the tail influences predisposition to strike. Sheep which have an extensive area of wool-growing skin on the upper surface of their tails are more likely to be struck than those which have only a small area of wool-growing skin on the top of their tails.

Body Strike.—Body strike refers to strike which commences on some part of the sheep other than on the breech, the head of rams or the pizzle. It occurs most commonly on the back or withers, on the point of the shoulder or on the rump.

Body strike is usually associated with continued wet weather which keeps the wool of the withers and back wet, or with heavy dews at a time when grass is long. This can keep the wool of the shoulders and apron wet and may result in body strike.

Pastoralists commonly state that blowflies will strike anything and they quote the occurrence of blowfly eggs or larvae on saddle cloths, but these are not the same species as those that strike sheep and body strike does not occur by accident. Sheep with misshapen withers and with devil's grip are particularly likely to suffer from body strike, because conformation of this type is likely to let moisture get down through the wool to the skin where it sets up bacterial activity which makes sheep susceptible to blowfly attack.

Head Strike of Rams.—Two factors can predispose rams to head strike. They are (1) fighting, and (2) the shape and set of the horns.

Suppurating sores may develop on the poll of the ram as the result of fighting and these soon predispose the animals to head strike. Horns which are set too closely to the head are usually considered to set up a degree of sweatiness around the poll of rams and this leads to bacterial activity which makes that part of the sheep attractive to blowflies.

Conditions which Render Sheep Susceptible to Strike.

Apart from the general attractiveness that all woolled sheep have for blowflies, and excluding wounds, certain conditions must occur on the skin of the sheep before they will be struck. The usual sequence is as follows:—

(1) Some part of the wool must be wet to the skin, and must remain wet.

(2) As the result of the moisture, bacteria on the skin multiply rapidly.

(3) An area of scald develops on the wet skin, and as a result the skin becomes red and sore.

(4) Blood serum exudes through the damaged skin surface and that provides more moisture which is enriched with nutriments on which bacteria thrive. This further hastens their multiplication and it is not long before the skin is severely damaged.

(5) As a result of these changes, a peculiar smell, which is attractive to blowflies, emanates from the scalded skin.

> Female flies alight on or near the moist area and lay eggs. On hatching, the maggots find conditions which are suitable to their particular requirements. There is ample food, protection and warmth, and as they grow bigger they attack the skin of the sheep and may tear their way right through it.

This sequence of events is followed almost irrespective of the location of the strike. Adequate moisture to soil the crutch and keep it constantly wet is provided by the urine voided by ewes. This is increased if the ewe has only a small area of bare skin surrounding the vulva and anus. If the bare skin is stretched and enlarged by the Mules operation, the crutch is not so likely to become urine soiled.

Similarly, any wool growing on the tip of the tail of ewes may become soiled with urine and thus susceptible to strike, and the wool around the pizzle of wethers can also be affected. As the result of heavy rain or consistently heavy dews on long grass, the withers, back or shoulders of sheep may be kept wet for a considerable period. As a result, fleece rot develops. This is an obvious manifestation of the bacterial changes which take place on the skin and amongst the wool of sheep which are continually wet. Fleece rot may occur as a yellow, green, brown, pink, purple or blue discoloration associated with matting of the wool. When fresh it has a peculiar musty odour and when dry it is friable and crumbly and in the majority of cases it renders sheep susceptible to body strike.

Most suppurating wounds are attractive to blowflies. If tails are cut short, the wounds are likely to become soiled with faeces and urine. In this way they become infected and may render recently marked lambs susceptible to fly strike. Similarly, rams may suffer from suppurating wounds on their heads as the result of fighting.

Wool growers often consider that ill health renders sheep susceptible to blowfly strike. It cannot be agreed that this is usually the case, although it is well known that heavy infestations of hair or nodule worm may lead to the passing of droppings which consist mainly of fluid or mucus. These may keep the sheep's crutch wet and in this way lead to the development of areas attractive to blowflies.

4. Seasonal Conditions in Relation to Blowfly Strike.

Two things are necessary for the development of a severe wave of blowfly strike:—

(1) Sheep which are susceptible to flies.

(2) A reasonably large fly population.

Plate 176.

Map Showing the Different Zones Which Have 66 per cent. or Greater Reliability of Effective Rains for Periods of Various Numbers of Months.

KEY TO PLATE.

Summer—				
Number of wet months	6	4	2	0
Symbol	A	B	C	D
Winter—				
Number of wet months	6	4	2	0
Symbol	a	b	c	d

Example—Area Bc has effective rainfall for four summer months or two winter months with a 66 per cent. reliability.

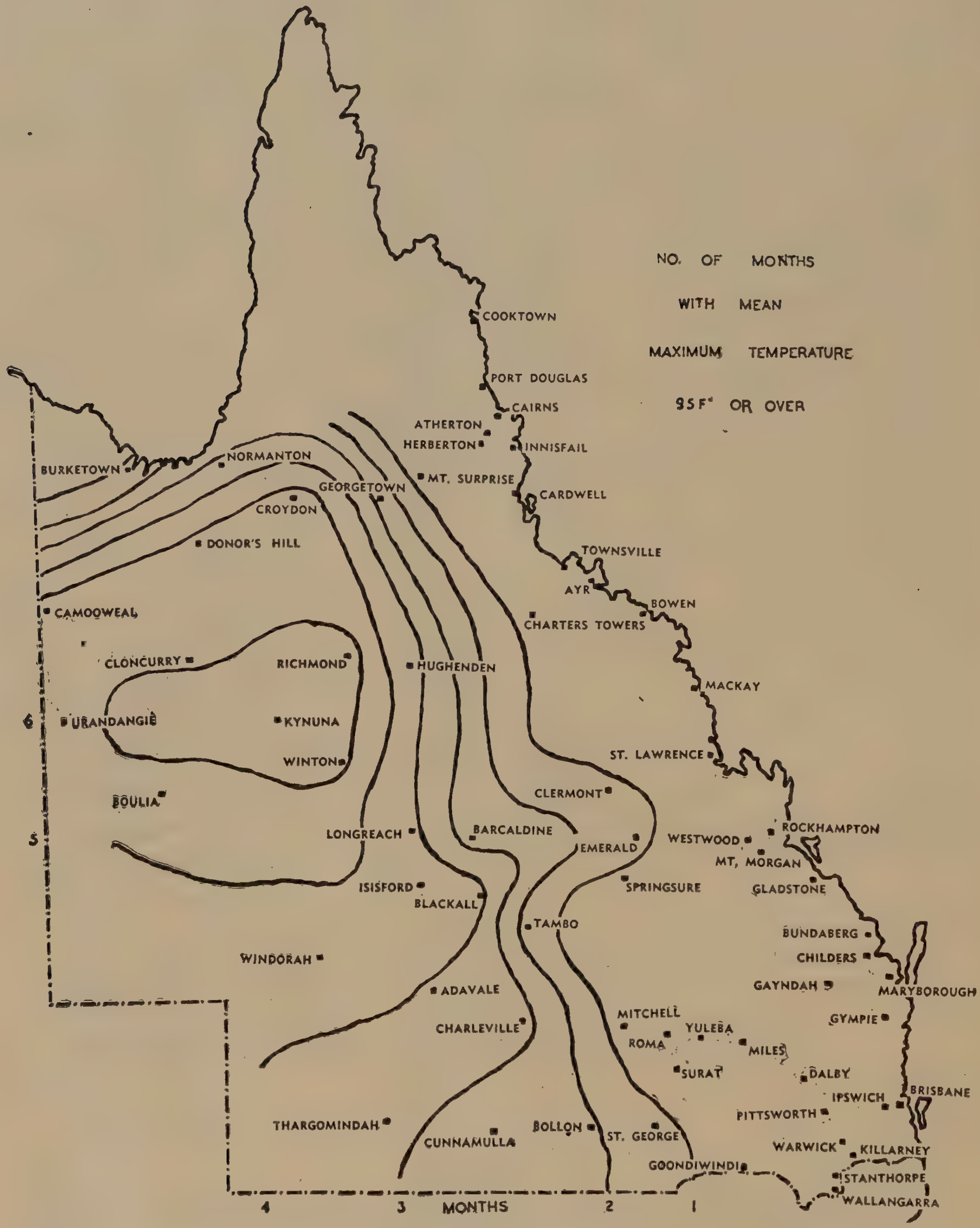


Plate 177.

Map Showing Number of Months With a Mean Maximum Temperature of 95°F. or Over.

Both of these are influenced by seasonal conditions. The main factors to consider are:—

(1) The distribution and intensity of the rainfall.

(2) The evaporation.

(3) The temperature of the air.

The distribution and reliability of the rainfall are important because they govern blowfly populations as well as the susceptibility of the sheep. An evenly distributed reliable rainfall ensures that a large number of blowfly maggots hatch out into adult flies. The intensity of the rainfall governs the amount of moisture in the fleece, and the evaporation and temperatures affect the rapidity with which the fleece dries. Temperature also influences the activity of any blowflies that are about and the rapidity with which their life cycle is completed.

A study has been made of rainfall in relation to evaporation in Queensland and of air temperatures. The results are presented in the maps in Plates 176 and 177. Plate 176 shows the number of months in which rains that equal a certain fraction of the total evaporation for the month occur. It is seen that the main Mitchell grass downs country of central and north-western Queensland have received their principal rains in two months of summer in 66 per cent. of the years for which records exist. In most years these rains have occurred during either January, February or March. The forest country, often referred to as the "desert," east of the open downs has received four months of summer rain in 66 per cent. of the years for which records exist, while the Clermont, Emerald and Springsure districts have received four months of summer rain or two months of winter rain in 66 per cent. of years.

Further south, the increasing importance of winter rain is apparent. In the Cunnamulla area, the winter rain is more reliable than the summer rain and to the east of this district occurs a long, wide zone which receives two months of rain in summer or two months in winter. In the Maranoa and Darling Downs the rainfall is more reliable and has a better distribution. Some districts receive four months of rain in summer or four months in winter.

The map (Plate 177) showing the number of months in which average monthly maximum temperatures exceed 95 degrees F. is of particular interest in relation to blowfly activity. In the north-west the long, hot summers tend to depress fly activity at that time. When this is considered in relation to the poorly distributed and unreliable rainfall in the north-west, it is not surprising that the blowfly problem is not as severe in that area as in the central-west and south-west. It is of interest that the cold weather experienced in the Maranoa in winter is sufficient to depress fly activity at that period.

Sterility in Cattle.

R. W. HEWETSON.

ONE of the most perplexing problems which has faced the livestock owner and the veterinarian during recent years is that of infertility in cattle in both dairy and beef herds.

In order to conduct a dairying or beef raising property successfully, particularly in these times of high operating and replacement costs, it is desirable that each female animal produce a live calf annually.

Diseases impairing reproduction strike at one of the fundamentals of animal production. Heifers and cows which are either temporarily or permanently infertile obviously fail to yield their maximum potential. Fewer calves mean fewer cows in milk and that of course means lower returns. Moreover, because there are more dry cows in the herd than normally, returns are still further reduced by reason of the cost of maintaining these additional non-productive animals.

This problem is particularly important to the wholemilk producer, who aims at calving his cows at certain periods of the year to maintain a constant production of milk for the city market.

Seasonal calving to utilize available seasonal flushes of pasture cannot be practised when sterility occurs in a herd as calving schedules are disrupted.

The stud-breeder who depends for a livelihood on the production of healthy calves for sale as future dairy or beef sires is also vitally affected by infertility in his breeding herd.

A herd wastage survey made of 122 Queensland dairy herds in 1949 showed an annual average culling rate of cows of 16·1 per cent. Of these, 4 per cent. were culled for permanent sterility and 7 per cent. for contagious abortion (brucellosis). This is an indication of the large annual economic loss from sterility which occurs each year in Queensland.

I. THE REPRODUCTIVE ORGANS.

In order to understand fully the problem of infertility in cattle, it is necessary to know something of the anatomy and functions of the reproductive organs of both sexes.

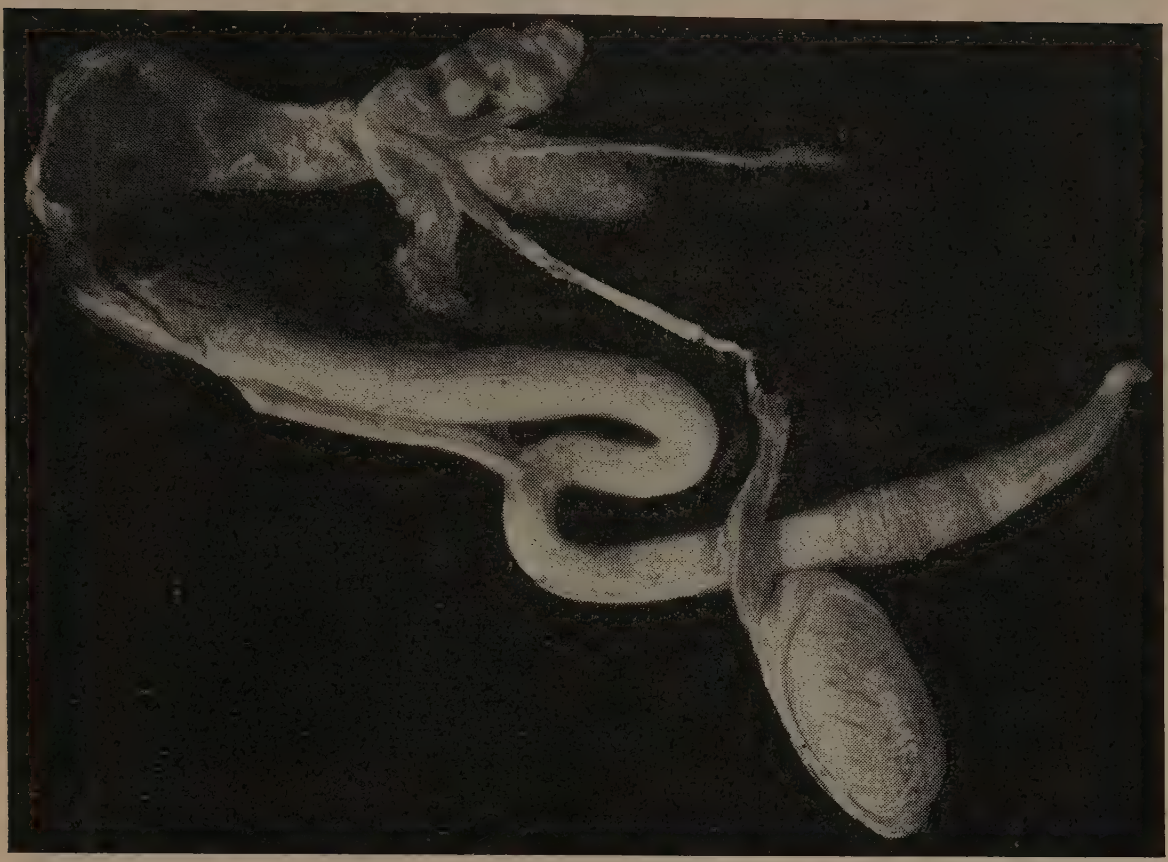
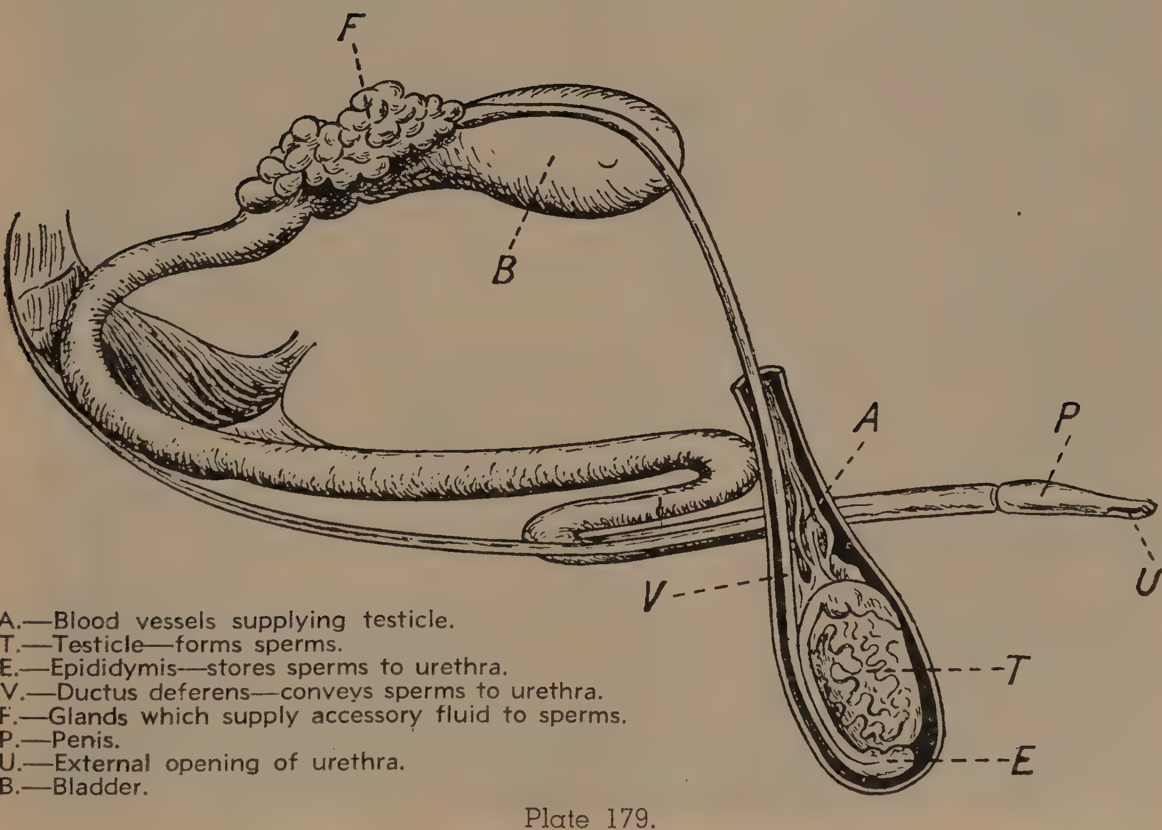


Plate 178.

Photograph of Reproductive Organs of the Bull. The parts are named in Plate 179.



A.—Blood vessels supplying testicle.
T.—Testicle—forms sperms.
E.—Epididymis—stores sperms to urethra.
V.—Ductus deferens—conveys sperms to urethra.
F.—Glands which supply accessory fluid to sperms.
P.—Penis.
U.—External opening of urethra.
B.—Bladder.

Plate 179.

Diagram of the Reproductive Organs of the Bull.

(*Taken from Ministry of Agriculture and Fisheries Bulletin* 39.)

1. The Bull.

In the bull, the reproductive organs (Plates 178 and 179) are composed of two testicles (testes) enclosed in a pendulous scrotum, a penis which is covered and protected by a sheath, and a number of accessory sex glands situated in the region of the bladder.

The sperm or male germ cells (Plate 180) are produced by the testes, in which they may remain fertile for 40 days and even as long as 60 days. It is often 60 days or more after sperm are formed in the testes that they are ejaculated in the act of mating. In artificial insemination centres, after a bull has had a long sexual rest it is necessary sometimes to discard one or two ejaculates because of the death of the sperm. This explains why the first few services of a bull which has been rested for some weeks may not result in conceptions.

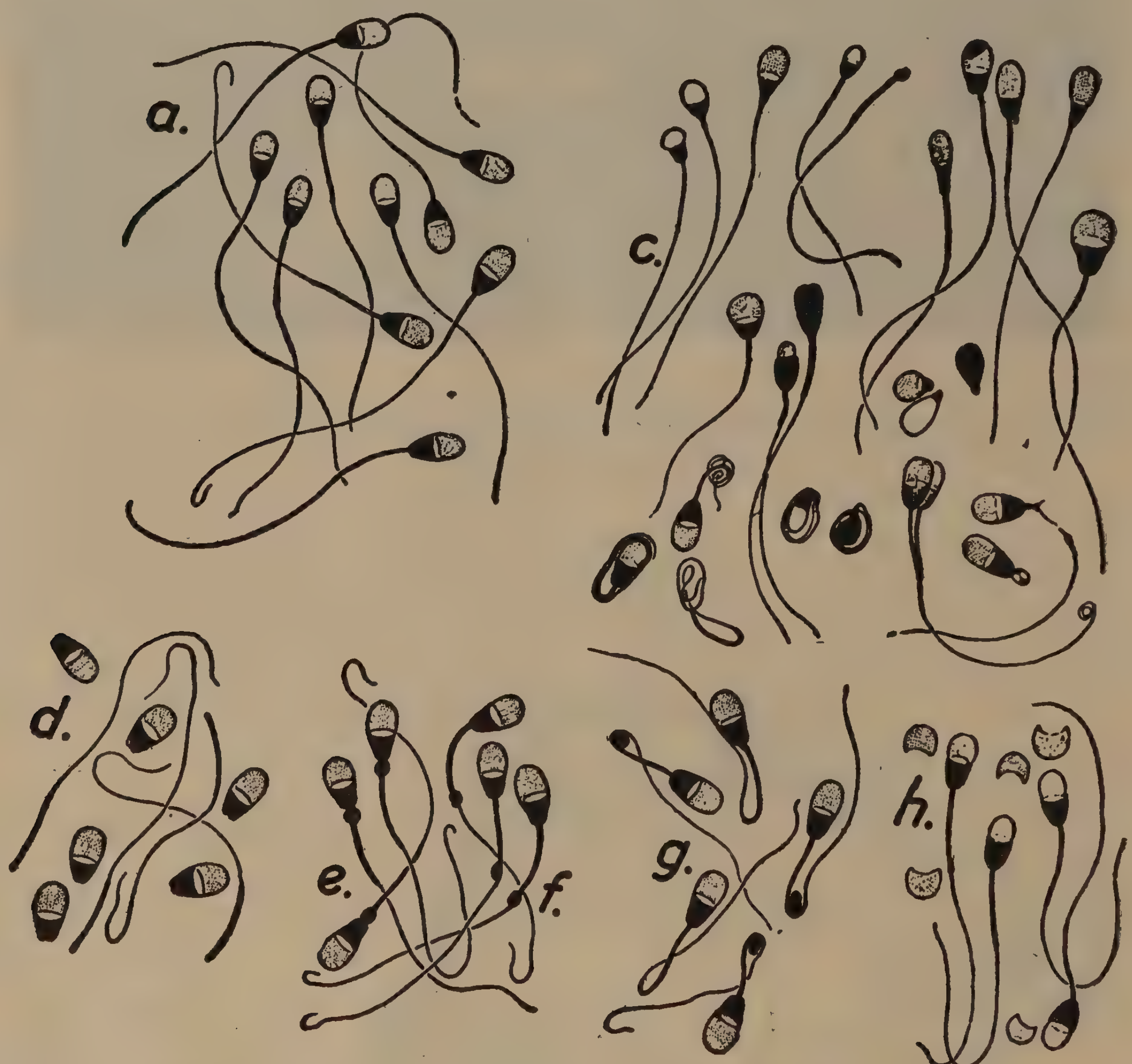


Plate 180.

Drawing of Various Types of Bull Sperms. a, normal; c-h, abnormal.

The sperms pass by a fine tube or excretory duct, which is called the ductus deferens, to a passage called the urethra. At or near the junction of the excretory duct with the urethra there are a number of glands which secrete an accessory fluid, the addition of which increases the volume of the semen. These glandular secretions activate the sperms so that they are able to ascend the female genital tract. At mating, the sperms pass down the urethra and are deposited in the female tract by the penis.

Plate 181.

Photograph of Reproductive Organs of the Cow, With Part of the Canal Cut Open. The parts are named in Plate 182.

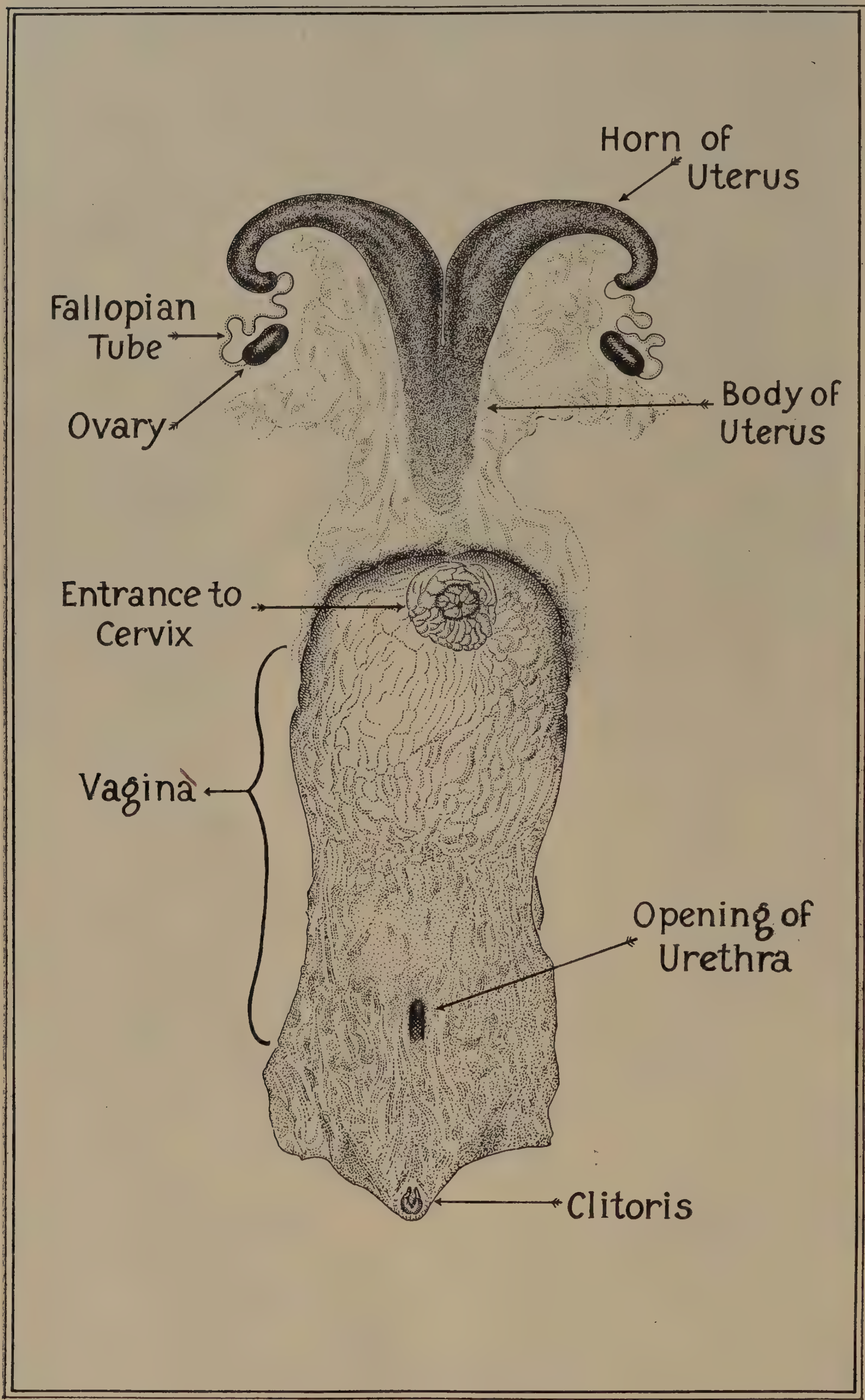


Plate 182.

Diagram of the Reproductive Organs of the Cow.

Plate 183.

Ovaries of the Cow. Left to right, top—Ovary showing corpus luteum; ovary cut to show the halves of the corpus luteum; mature follicle in ovary ready to ovulate. Left to right, bottom—Two ovaries sectioned to show immature follicles; normal quiescent cvary.

The male hormone controlling sexual behaviour is secreted by the testes. It is a chemical substance and is responsible for the desire and the power to mate. It must be recognised, however, that the mating power of a bull is no criterion of his ability to get cows in calf. It has been noticed that bulls of all degrees of fertility show considerable variation in their desire to mate and not uncommonly a completely sterile bull will be keener and more capable of service than a highly fertile one.

2. The Cow.

The production of ova, or female germ cells, in the cow is a function of the ovaries (Plates 181-183), which are roughened ovoid bodies, up to one inch long, situated in the pelvic cavity. Once the ovum (or egg) has ripened or matured in the ovary it is extruded and conveyed by the Fallopian tubes (or ''webbing'') to the corresponding horn of the uterus (or womb). If fertilised there, it develops into a calf.

The two horns of the uterus come together at one end to form a single compartment which is known as the body of the uterus. At its hindmost end the body is continuous with the cervix or neck of the womb. This portion of the uterus is thick-walled and has only a narrow and somewhat tortuous canal instead of the relatively large cavity which is present elsewhere. Except at calving time, the cervix is a substantial barrier to the uterus proper and can only be pentrated by way of the cervical canal which opens into the broad passage known as the vagina. In the floor of this passage is the opening of the urethra, which conveys urine from the bladder to the vagina and so to the exterior.

At service, the sperms are deposited by the male in the vagina of the cow and they then make their way through the cervix into the uterus to fertilize the egg.

II. OESTRUS AND THE SEXUAL CYCLE.

The female has a rhythmical sexual cycle, usually of 21 days, which can be divided into three stages:—

(i.) The ripening of the egg in the ovary and the preparation of the uterus to receive it;

(ii.) The release of the egg from the ovary. External signs of heat are shown by the female 13 to 15 hours before the egg is released;

(iii.) The attachment and commencement of development of the egg if mating results in conception, or in the event of non-conception the absorption of the egg and return of the uterus to normal.

The "yellow body" or corpus luteum develops in the follicle from which the egg has been released. While this yellow body persists in the ovary the cow will not come on heat. In a normal cycle the corpus luteum persists for 17 to 18 days. In the pregnant animal the yellow body persists throughout the gestation period, secreting a hormone which represses heat. Regression of the corpus luteum at calving time allows the production of other hormones necessary for normal calving.

It sometimes happens that regression of the corpus luteum does not occur during an ordinary cycle, and if this happens the normal cycle ceases and cows do not come on heat. This may occur secondarily to some infective process.

The whole cycle is controlled by a series of hormones produced by the pituitary body and the ovary. The pituitary body is a small gland situated at the base of the brain, and apart from producing hormones on its own account it initiates the production of other hormones by the ovaries. Oestrus or heat occurs on the average every 21 days, but there may be individual variations in the period ranging from 16 to 24 days.

The length of oestrus varies but is usually 13 or 14 hours. Heat may as be short as 8 hours or as long as 30 hours. Because of this fact, cows having short heat periods may be missed if they come on heat during the night.

Ovulation, or the bursting of the follicle to release the egg, occurs 13 to 15 hours after the end of the heat period.

Most farmers will recognise the symptoms of heat in the cow without difficulty, but the following points may assist:—

(1) Standing when mounted. Some cows remain standing whilst being mounted by other animals. Ruffled hairs over the tail head indicate that a cow has been mounted.

(2) Attempting to mount. Some cows attempt to mount other cows and generally behave like bulls.

(3) Bawling or bellowing and general restlessness. Some urinate frequently during this period.

(4) Discharge of mucus from the vulva. This mucus is transparent and has the consistency of egg-white during heat. Strings of mucus on the tail or hindquarters glisten and sparkle in the sun. There may be a bloody discharge, usually two days after the onset of heat.

(5) Swollen, flabby and wet vulval lips. The lips appear wider and thicker and mucus is smeared over them, giving a moist appearance.

(6) Pink glistening vulval walls. The increased flow of blood through the fine network of blood vessels gives a pink colour to the walls. In addition, some animals show a reduced milk production whilst on heat, which is generally conceded to be due to a "hold up" of milk.

Some cows have quiet heats and do little mounting; they are often missed unless close observations are made for ruffled hairs and mucus discharge.

III. MANAGEMENT OF THE BULL.

On many farms management of the bull is unsatisfactory. Controlled mating and hand service is the exception rather than the rule.

For most efficient utilisation of semen and highest conception rates, two services only are allowed a bull each week in artificial insemination centres, and the bull is kept well fed.

1. Feeding.

A considerable amount of sterility is due to defective sperm production by the bull. This is found particularly in young bulls which have been under-fed and over-worked, and in old bulls which have been over-fed and under-worked.

With notably few exceptions, the food requirements for reproduction, both in quality and quantity, do not exceed those for maintaining animals in good health. The exceptions are vitamin A and protein, both of which are abundantly supplied in young green grass and in first quality lucerne hay.

A deficiency of vitamin A, if sufficiently prolonged, causes wasting of the testes and damage to the mechanism of sperm production.

There should be ample protein available to supply normal maintenance requirements. *On the other hand, too high a protein intake may be responsible for infertility.* A number of people consider that some animal protein in conjunction with vegetable protein is desirable for the production of high-quality semen.

Starvation in early life before puberty retards or arrests sexual development, delays puberty and suppresses the production of sperms.

A word of warning is necessary on the practice of feeding large quantities of roughages, or, for that matter, any other practice leading to the production of "pot-bellies" in bulls. Overlarge abdomens will interfere with service, the "pot" belly acting as a mechanical obstruction to the insertion of the penis.

Bulls should be maintained in hard condition, which is produced by sufficient exercise to work off excess fat. An area of at least one acre is desirable for a bull paddock and this paddock should be provided with a shelter shed, feeding facilities and service yard.

A beast increasing in weight is more likely to be highly fertile than one losing weight.

With bulls, the time when a nutritional deficiency occurs is important. Sperm formed in the testes may not be ejaculated for as long as 9 weeks after formation. Bulls brought onto good feed after having been on short commons may take some 9 or 10 weeks to achieve the production of good quality semen.

Seasonal changes in semen production have been observed in bulls. Changes appear to be associated with, or are actually caused by, atmospheric temperatures and nutritional deficiencies, although some as yet unexplained factors may be involved.

It is therefore necessary to take a broad view of bull feeding and aim at providing a good ration. The ration should be well balanced and provide ample protein, carbohydrate, minerals and vitamins. Some animal protein may result in increased fertility. A supplementary mineral mixture may be necessary, its composition depending on local circumstances. Phosphorus, calcium, and perhaps copper, are the only minerals likely to be deficient in Queensland.

Green feed should be fed wherever possible. Lack of green material and hence of vitamins may be important in the prolonged dry seasons of the tropics and sub-tropics in lowering fertility in males. When the breeding season is restricted, full feeding should start some weeks before and continue throughout the period. Older bulls, especially those of beef breeds in fat condition, may become sluggish and it may be necessary to starve them for short periods to increase their vigour.

Drugs such as opium, strychnine, cantharides and yohimbine, which are sometimes used to promote sexual excitement, are not recommended unless used under veterinary supervision, as in the end they will lower rather than increase the breeding powers of the animal.

2. Care of the Young Bull.

Most young bulls reported sterile have been overworked. They serve cows efficiently but fail to get them in calf. They have usually been turned in with the cows at an early age. This has allowed the bull to serve each cow several times, so instead of being allowed to serve 10 or 15 cows once or twice, he has probably been allowed anything up to 100 services in his first year. The bull simply fails to stand up to such heavy services.

The following rules for the use of young bulls should be observed:—

(1) Do not use a bull before he is a year old—segregate male and female calves before they become sexually mature.

(2) Be sure the bull is not overworked. A yearling bull can serve 10 to 15 cows with safety during the first year of service, but services should be reasonably spaced.

(3) Never allow the bull to run with the cows. Careful hand service should be practised and services should be limited to a single leap.

(4) Feed a balanced ration which keeps the bull growing without making him fat.

(5) Carefully control roughage intake, paying particular attention to quality, to avoid "pot-bellies."

(6) Inspect the feet regularly and keep them trimmed.

(7) Provide the bull with sufficient exercise.

(8) Keep a close check on worm infestation. Young bulls should be dosed regularly with phenothiazine to keep down worm burdens and, where possible, pastures should be changed regularly.

3. Mating.

The common practice of allowing the bull to run with the herd is not good husbandry. Controlled mating with hand service is much to be preferred. If this latter practice is adopted, the bull can be used on more cows and kept in much better vigour. Instead of several services per cow when running with the herd, a bull whose services are controlled need only serve cows once, or at the most twice if it is desired that a second service be given towards the end of the heat period.

Bulls become used to the method of management at service and the environment of the service yard, and if these are altered, particularly by transfer to another farm, there may be at first a disinclination to mate.

Young bulls may play with a cow on heat without achieving results, but if persevered with, sexual desire is usually acquired.

Over-exertion, inability to serve, or pain felt every time the bull mounts the cow may cause reduction or loss of sexual desire.

Infections following injury may result in adhesions of the penis to the prepuce and inability to protrude the penis. Such injuries are often referred to as "broken pizzle." It is very difficult to remedy such cases.

Most observations indicate that mating behaviour and sperm production vary independently of each other. In the bull willingness and ability to mate are not an indication of his ability to get cows in calf.

It has been observed that a longer time getting ready to mount has had a beneficial effect on sperm production. The superiority of second over first service by the bull when carried out within a short time is probably associated to some extent with greater efficiency of service and the ejaculation of younger and more active sperms.

IV. MANAGEMENT OF THE COW.

Often a veterinarian is called in to investigate infertility in a herd only to find that the farmer has no records of service dates or heat periods and only a vague idea of when his cows will calve.

Records of heat periods and service dates are invaluable to the dairy farmer himself if he is to run the farm efficiently. A knowledge of when the cows are due to come in will help in a planned milking programme. Especially is this so if seasonal calving is planned to make the most use of the spring and summer flush of feed. There is some evidence to show that the withholding of service for 60-90 days after calving favours conception. A suggested form of record is:—

MATING RECORD.

Name or Number.	Date Last Calved, and if Normal.	Dates on Heat.	Served or Not Served.	Bull's Name.	Date Expected to Calve.
Mary	13/12/49	3/1/50	Not Served.	.. ..	.. ..
	Calf dead	24/1/50	Served.	Duke	5/11/50
		14/2/50	Served.	Prince	26/11/50

Records kept in the above manner are of untold value to the person investigating infertility in a herd and at the same time notify the farmer immediately if he is having trouble with the service programme.

1. Feeding.

Malnutrition may affect the reproductive system in a variety of ways, directly or indirectly, and may take a number of forms. Under practical conditions, cases of malnutrition are rarely due to the deficiency of one factor in the feed, but more commonly to a variety of factors.

Underfeeding may be accompanied by poor quality of feed. Thus an energy deficiency is often accompanied by a protein, phosphorus or vitamin A deficiency, and a protein deficiency by phosphorus deficiency.

Malnutrition usually results in lowered vitality, so it is reasonable to suggest that any form of malnutrition lessens resistance to disease.

Generally the young animal is more susceptible to deficiencies than the adult. Early malnutrition prevents the orderly growth of the reproductive organs as a fully developed system. When this occurs, it is difficult and sometimes impossible to initiate the correct balance for proper development as irreparable damage may have occurred. Reproduction having begun, the problem tends to be easier as it is then only a question of maintaining in smooth operation an organisation already established. Reserves have been accumulated in the mature animal giving it greater resistance than the growing animal which is still using all available food for growth. For this reason more attention should be paid to the growing animal. Prevention rather than cure should be the aim of all good husbandry men.

Specific dietary deficiencies rarely cause specific lesions in the reproductive tract. They usually produce general effects leading to infertility.

(a) General Starvation.

Calves badly fed are late in reaching sexual maturity. Heifers fed heavily experience their first heat much earlier than heifers fed lightly.

Cows which are underfed may not come on heat regularly. However, once conception takes place the calf is usually carried to full time.

(b) Minerals.

The mineral most likely to be deficient in Queensland is phosphorus. Phosphorus deficiency tends to occur where the diet is low in protein when the grass is dry. Soils low in phosphorus generally produce pasture deficient in this mineral.

Generally, reproduction does not suffer until cattle show clinical signs of phosphorus deficiency—that is, unthriftiness, rough coat, a depraved appetite and a reduced milk yield.

In phosphorus deficient areas there are reports of herds in which not more than half of the cows have a calf each year although there are no more than the usual number of abortions. It is usual in these areas for heifers not to come on heat until they are two years old.

The effect of phosphorus deficiency is more evident in the winter and spring months when pasture generally is lowest in phosphorus. Cows suffering from phosphorus deficiency may fail to come in season, but after the drain of milk production has ceased with drying off, heat periods return with normal chances of conception.

Phosphorus deficiencies may be overcome by feeding phosphorus supplements or by phosphorus topdressing of pastures and crops. Superphosphate topdressing, however, is not successful in all areas because of what is referred to as a "lock-up" of phosphorus in some soils.

Phosphorus supplementation is usually undertaken by feeding small quantities of bonemeal. This can be fed at the rate of 2 oz. a day per beast if hand feeding is practised or given as a lick with equal parts of salt.

Recently, it was found that the addition of superphosphate to drinking water at the rate of 2 lb. per 100 gallons of water would supply sufficient phosphorus. It is, however, necessary that the whole of the superphosphate be added to one gallon of water first and the undissolved deposit discarded, the clear separated fluid alone being used. This procedure disposes of most of the harmful fluoride present in superphosphate. Solutions prepared as above can be added to the feed at the rate of one-quarter of a pint per head daily if the herd is hand fed.

In addition to phosphorus deficiency, calcium deficiency has been thought to cause reproductive failures in cattle, but this is much less common. Although calcium deficiency may occur in cattle, it is not nearly so common as phosphorus deficiency.

Copper deficiency may occur in some of the coastal areas of Queensland. A lack of copper will cause a suppression of oestrus and the birth of weak calves.

(c) Vitamins.

Vitamin A deficiency has caused the birth of dead and weak calves, with the retention of the "cleanings" or foetal membranes.

It is not likely that a vitamin A deficiency will occur except in prolonged dry seasons, as cattle have the capacity to store vitamin A in the liver.

Extravagant claims have been made from time to time for the use of vitamin E. It is known that adequate amounts of this vitamin are necessary for normal attachment of the egg. However, there are reports of raising heifers on a vitamin E free ration with no calving abnormalities.

(d) Over-feeding.

It is generally accepted that over-fat cows have more difficulty in conceiving than do others. It may be argued that the tendency to fatten denotes an hereditary ovarian imbalance which would in itself impair fertility. Fat is laid down in the ovary as well as the body tissues generally, and the effect is to interfere with the ripening of the follicles.

In quick fattening beef breeds it is often noticeable that fatness is associated with infertility.

2. Mating.

The cow comes on heat for an average of 13 to 14 hours approximately every 21 days, and the egg is released 13 to 15 hours after the cessation of heat. Because of this fact it is very important that cows should, as far as possible, be mated towards the end of the heat period—and so a cow on heat in the morning if mated immediately and still on heat in the evening should be mated again. Cows coming in season in the evening should be mated once and, if still on heat next morning, mated again.

V. SOME PHYSIOLOGICAL ABNORMALITIES.

The experience of some veterinarians suggests that hormonal abnormalities are usually the result of disease factors which have upset the normal hormone balance. (There is a delicate balance between all

hormones of reproduction.) Primary hormone imbalance in cattle is rare and this leads to the belief that functional sterility is usually the result of disease or malnutrition.

There are a number of conditions which may be treated with hormone preparations, but the aid of a veterinarian should be sought before treatment is contemplated. They are:—

(1) *Infantile ovaries.*—The failure to develop ovaries past the infantile stages in some heifers may be due to:—

(*a*) Late development;

(*b*) Some genetic factor;

(*c*) Malnutrition in early life.

(2) *Shrunken ovaries.*—The condition of ovarian hypoplasia, or shrunken ovaries, in the adult has points of similarity to that of infantile ovaries but the condition found seems to be more variable. The cause of this condition is malnutrition.

(3) *Persistent "yellow body" or corpus luteum.*—The cause of this condition is not known, but it may occur secondarily to some infective condition.

(4) *Nymphomania.*—In this case cows come on heat at irregular intervals which may be as close as three or four days. The condition is due to production of follicular cysts in the ovary. It can be caused by inexpert use of certain drugs of the oestrogen group.

(5) *Seasonal infertility.*—Cows in which heat periods may be regular or irregular present a most important problem because they give the opportunity for breeding but much time is wasted in trying to get them into calf. From the absence of definite signs of abnormalities, it is difficult to know when to begin to treat them as sterile cases. A relatively infertile bull is not as successful with this class of cow as a highly fertile one. Service at the end of the heat period may be helpful.

VI. DISEASES OF THE REPRODUCTIVE ORGANS.

The ability to reproduce may be temporarily impaired during the course of any general condition associated with sickness or an increase in body temperature. In bulls the ability to produce sperm may be affected and the quantity and quality of semen markedly altered. Especially is this so in diseases such as tick fever in which there is a sudden rise in temperature followed by several days of fever.

Absolute sterility does not result from most genital infections. A few of short duration have no lasting effects, whilst others may cause permanent changes which make reproduction difficult or impossible in bulls. Damage to the testicles and accessory glands may result. In cows extensive adhesions around the ovaries, blocking of the tubes, and destruction of the walls of the womb may result along with enlargement and distortion of the cervix.

Chronic infections may persist, resulting in lowered fertility.

Still other infections interfere with the production of living young, the infection subsiding as resistance is acquired. Some diseases (such as brucellosis) cause death of the calf or interrupt pregnancies when established. A characteristic of these diseases is that they usually affect the uterus and foetal membranes.

Other infections cause pain at mating and prevent service. Diseases of the reproductive organs can be divided into specialised and unspecialised diseases.

(1) Unspecialised Diseases

Into this group go the infections causing disease in other parts of the body as well as the reproductive tract. They are either non-contagious or only slightly contagious, and are usually associated with the production of pus. The pus-forming infections may be transferred at mating, but are not venereal in nature and do not occur in outbreaks.

Metritis or infection of the womb in females.—Metritis is the term used to describe an inflammation of the womb. If there is pus formed it is termed pyometra. There may be other parts of the reproductive tract infected separately or in combination with the womb, and various terms are used to describe the resulting conditions. One which is most familiar is vaginitis, meaning inflammation of the vagina.

In cows lacerations may allow the entry of infections or the infection may be secondary to a condition such as contagious abortion.

Infection of the unborn calf with subsequent abortion and the formation of pus may occur as the result of metritis.

A common sequel to farmers washing out cows after calving is the setting up of an infection in the womb which will undoubtedly lead to infertility. Washing out should not as a general rule be undertaken because it is necessary to withdraw all fluid from the womb; a small amount left in the womb provides the means for the development of an infective process. If cows will not "clean" or have a persistent discharge, especially noticeable whilst on heat, veterinary assistance should be sought.

It is possible with the use of iodine preparations and hormones in skilled hands to clear up infections of this kind.

(2) Specialised Diseases.

These are contagious diseases caused by specific infections, characterised by the fact that they occur in certain species and always in the same organ. They have a more or less general pattern of involvement of, and definite predilection for, the genital system.

There are a number of diseases present in cattle which affect the uterus particularly.

(i.) Brucellosis or contagious abortion.—Among infectious diseases causing sterility, bovine brucellosis is still the most common. Great financial loss is suffered each year by farmers whose cows are infected with this desease as a result of abortion and the sterility which is often an aftermath. Cows which abort as a result of brucellosis often fail to clean properly because of infection of the womb and membranes.

Rational means of combating this disease are now available with the use of Strain 19 vaccine. For further information on brucellosis, farmers should consult the Departmental leaflet on the disease.

(ii.) Bovine venereal trichomoniasis.—This is a venereal disease; that is to say, it is transmitted during the act of mating. However, mechanical transfer may occur readily between females through use of instruments such as syringes or specula if care is not taken to sterilize them between cows.

Bulls once infected remain so for life and may spread the disease throughout the herd. The disease does not harm the bull himself but his transmission of the disease makes him unsuitable as a sire.

In affected herds the most conspicuous symptom is sterility. This is accompanied by early abortion at from two to four months. Most females return to service within three to five weeks.

Trichomonas infection continues for several months, during which time the females are infertile. Some females may abort very small calves or the calf may be mummified or reduced to pus. Pus in the womb may persist for up to a year and on rectal palpation the womb may feel similar to one in the early stages of normal pregnancy.

On recovery, most females are resistant to infection. However, the immunity is eventually lost and mating with an infected bull results in reinfection.

It is reasonable to suspect that the disease is more widespread in Queensland than present diagnosed cases indicate. There is some difficulty in the diagnosis of the disease because of the fact that the infective organism is not continuously present in the discharges. If an aborted calf, preferably with unruptured membranes, is sent to one of the Department's Animal Health Stations within a reasonably short period, diagnosis is easier.

The complete eradication of this disease from affected herds is the only effective means of handling this condition and is ultimately the most economical course to pursue.

Eradication of the disease involves the following steps:—

(*a*) Recognising infected bulls and withdrawing them from service. This involves veterinary assistance in obtaining suitable specimens for examination under the microscope.

(*b*) As cows usually throw off the infection on their own account within three or four months if not served, known infected or suspected infected cows should be withheld from service for that period and then put to a clean (non-infected) bull.

Treatment of infected bulls is still not satisfactory, but experiments in that direction are continuing.

(*iii.*) *Bovine vibrionic abortion.*—This disease has also been known to occur in Queensland although it has only been diagnosed in a few isolated herds.

The disease resembles brucellosis inasmuch as abortions occur at somewhat the same period of pregnancy. Pregnancies may be terminated at almost any stage, but most frequently during the fourth to sixth months.

The manner of spread is unknown. Abortion rates of up to 20 per cent. of a herd have been observed. A passing sterility is usually associated with this disease; cows come on heat, but do not go in calf.

To control the disease general procedures of animal hygiene are indicated. Abortions should be anticipated and animals isolated.

The disease appears to be self limiting and has usually disappeared from a herd within a period of 12 to 18 months.

Diagnosis is made by examining the aborted calf and membranes at a laboratory, for which purpose the calf should reach the Animal Health Station as soon as possible after being aborted.

(*iv.*) *Vaginitis.*—As its name implies, this disease is an inflammatory condition of the lining walls of the vagina. There are several kinds, but the so-called granular vaginitis is most common. In females the slightly raised nodules may be confined to just inside the lips of the vulva, or there may be a general distribution of nodules over the whole surface of the vagina, with fairly severe inflammation. In very severe cases there may be production of pus. Similar nodules may be found on the inside lining of the sheath, and on the penis of the bull, and this is often referred to as bull "burn."

Some animals exhibiting these nodules may be found in most herds of cattle, including some free from infertility trouble. Nodules may be found in immature virgin heifers and it is also not unusual to find nodules in females in all stages of pregnancy.

It is therefore difficult to be certain as to the role played by granular vaginitis in relation to infertility, but where the condition exists and infertility trouble is being experienced action should be taken for its control. Once it has been eliminated, the conception rate does improve in most herds. indicating some beneficial effect from treatment.

Vaginitis should not be confused with diseases causing abortion or with the many other conditions which cause sterility in cows. The term should be reserved to describe inflammation of the vagina and not sterility in general.

The most effective treatments are those consisting of some astringent agent incorporated either in liquid or powder form. Most of the chemicals used are relatively cheap and can be made up by the farmer himself.

VII. HEREDITARY DEFECTS.

Research investigation and large numbers of observations indicate that fertility is to some extent hereditary.

The nature of the hereditary factors involved is not known. In general, a reduction in fertility is thought to accompany reduction in size, and is sometimes associated with inbreeding. Infertility may be inherited in a similar manner to other unfavourable characters.

The following are conditions affecting fertility which are thought to be hereditary:—

White Heifer Disease.—This disease has been observed most commonly in white Shornhorn heifers, but isolated cases are reported as occurring in roan and red Shorthorns, Aberdeen Angus and Friesians.

It is characterised by the persistence in development of a membrane stretching across the vagina just in front of the entrance of the urethra. This is known as a closed or persistent hymen which prevents sperm entering the uterus. This may be associated with a general infantilism of the reproductive organs.

Freemartin.—This occurs only in twins of unlike sexes. In about 90 per cent. of all mixed twins the female is sterile. All attempts to treat this condition have failed. With such a small chance of the heifer's being fertile it is probably wise to cull all females of mixed twins.

Absence of ovaries.—Some heifers have virtually no ovaries and a small uterus, cervix and vagina.

Defective testicles.—A condition in which sperm are not produced because of lack of development of sperm-forming cells of the testes is sometimes found. The testicles are undersized and their substance is flabby. When this condition occurs in both testicles there may be normal or increased desire to mate, but no sperms are produced.

Inability to serve.—The bull may be unable to serve because of mal-development of the penis. The condition is hereditary and once it is seen in a herd all relatives should be culled rigorously.

Umbilical hernia.—In the male, hereditary umbilical hernia may constitute a barrier to service. It is therefore wise not to keep a sire from a cow or bull which has thrown offspring affected with hernias.

Intersex or hermaphrodism.—With this condition, bulls appear to develop masculine traits normally but examination reveals an absence of testes and the presence of fully developed portions of some of the female organs.

Semen quality.—It has been noticed that some bulls produce semen of poor keeping quality. Others have produced sperms with abnormal shape.

Cryptorchid.—One of the most common structural abnormalities of the male is the retention of the testes in the abdominal cavity. If both testes fail to descend the bull will be sterile. The testes cannot produce sperms unless they are in the scrotum. This is because they are very sensitive to normal body temperatures. A bull with one testicle in the scrotum and the other in the body cavity although often fertile should not be bred from as cryptorchidism is hereditary.

VIII. SUMMARY OF TREATMENT FOR INFERTILITY.

(1.) Keep a careful watch for heat periods and serve at the correct time. Accurate records will provide information as to when to expect the next heat and do much to help in diagnosis of breeding problems.

(2) Control matings and adopt hand service.

(3) Feed animals correctly—correct any mineral deficiencies.

(4) Look after the herd sire—see he has a balanced ration and has sufficient exercise.

(5) Use Strain 19 vaccination with heifers between 4 and 8 months in herds suspected to be infected with brucellosis or in herds in which infection is likely to occur.

(6) Breed from the middle to the end of the heat period.

(7) Be sure that cows are not in-calf before they are sold as sterile.

(8) Call in veterinary assistance if abortions are occurring in the herd or difficulty is being experienced in getting cows in-calf.

TUBERCULOSIS-FREE CATTLE HERDS.

(AS AT 20th APRIL, 1951.)

Breed.	Owner's Name and Address of Stud.
Aberdeen Angus	The Scottish Australian Company Ltd., Texas Station, Texas F. H. Hutton, "Bingegang," Dingo
A.I.S.	F. B. Sullivan, "Fermanagh," Pittsworth D. Sullivan, "Bantry" Stud, Rossvale, *via* Pittsworth W. Henschell, "Yarranvale," Yarranlea Con. O'Sullivan, "Navillus Stud," Greenmount H. V. Littleton, "Wongalea Stud," Hillview, Crow's Nest J. Phillips and Sons, "Sunny View," Kingaroy Sullivan Bros., "Valera" Stud, Pittsworth Reushle Bros., "Reubydale" Stud, Ravensbourne H. F. Marquardt, "Chelmer," Wondai W. G. Marquardt, "Springlands," Wondai
Ayrshire	L. Holmes, "Benbecula," Yarranlea J. N. Scott, "Auchen Eden," Camp Mountain
Friesian	C. H. Naumann, "Yarrabine Stud," Yarraman J. F. Dudley, "Pasadena," Maleny
Jersey	W. E. O. Meiér, "Kingsford Stud," Rosevale, *via* Rosewood J. S. McCarthy, "Glen Erin Jersey Stud," Greenmount J. F. Lau, "Rosallen Jersey Stud," Goombungee G. Harley, Hopewell, Childers Toowoomba Mental Hospital, Willowburn Farm Home for Boys, Westbrook F. J. Cox and Sons, "Rosel" Stud, Crawford, Kingaroy Line R. J. Browne, Hill 60, Yangan P. J. L. Bygrave, "The Craigan Farm," Aspley A. Verrall and Sons, "Coleburn Stud," Walloon R. J. Crawford, "Inverlaw Jersey Stud," Inverlaw, Kingaroy P. H. F. Gregory, "Carlton," Rosevale, via Rosewood

1951 SHOW DATES.

June.

Boonah ..	1 and 2
Childers ..	4 and 5
Bundaberg ..	6 to 9
Mt. Morgan ..	7, 8 and 9
Lowood ..	8, 9 and 11
Gin Gin ..	11 and 12
Gladstone ..	14, 15 and 16
Toogoolawah ..	15 and 16
Rockhampton ..	20 to 23
Kilcoy	22 and 23
Mackay ..	26, 27 and 28
Esk	29 and 30
Proserpine ..	29 and 30
Home Hill ..	29 and 30

July.

Charters Towers	2, 3 and 4
Bowen ..	4 and 5
Nambour ..	5, 6 and 7

July—continued.

Rosewood ..	6 and 7
Ayr	6 and 7
Townsville ..	9 to 12
Laidley ..	13 and 14
Redlands ..	13 and 14
Tully ..	13 and 14
Ingham ..	13 and 14
Maleny ..	13 and 14
Cairns ..	17 to 20
Gatton ..	19, 20 and 21
Woodford ..	20 and 21
Atherton ..	23, 24 and 25
Innisfail ..	27 and 28
Pine Rivers ..	27 and 28

August.

Brisbane ..	3 to 11
Redcliffe ..	17 and 18
Cooroy ..	25

Brucellosis Testing of Swine.

The Department of Agriculture and Stock is operating a scheme whereby pig herds are tested at intervals for the occurrence of swine brucellosis (contagious abortion).

A herd listed by the Department as ''brucellosis tested'' is one in which all such animals as may be determined by the Director of the Department's Division of Animal Industry have been subjected to two successive tests for brucellosis, at intervals determined by him, without any positive reactors being found.

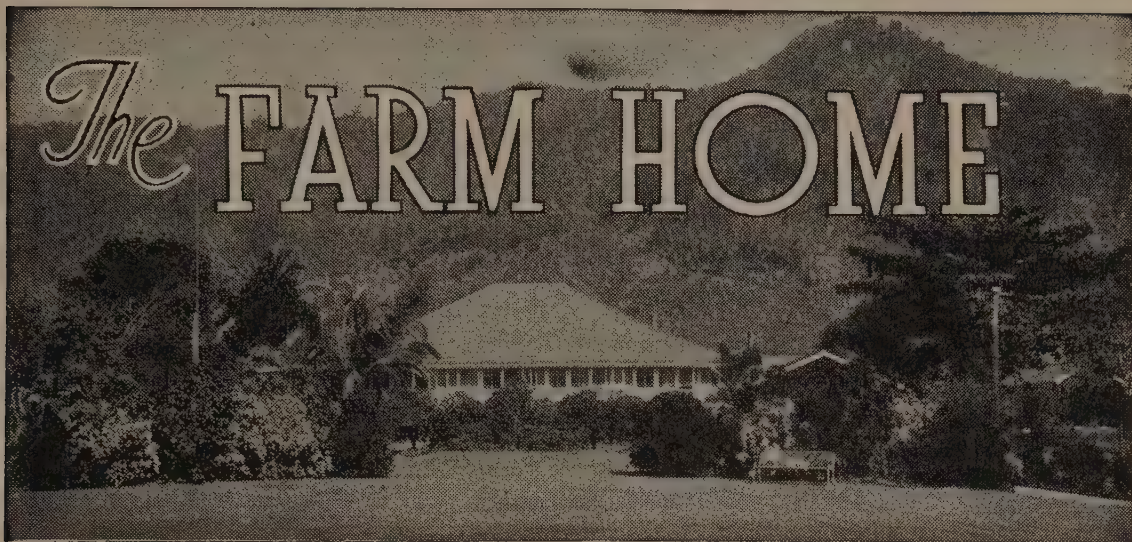
In order for a herd to be retained on the list of Tested Herds, a semi-annual or annual re-test of the herd, as determined by the Director, is required. If at a re-test any animal gives a positive reaction to the test the herd is removed from the list; it is not listed again until subsequent tests, as determined by the Director, have been carried out.

Full particulars of the Brucellosis Testing of Swine and application forms may be obtained from the Under Secretary, Department of Agriculture and Stock, William Street, Brisbane.

TESTED HERDS.

(AS AT 20th APRIL, 1951.)

Breed.	Owner's Name and Address of Stud.
Berkshire	S. S. Ashton, " Scotia " Stud, Pittsworth
	J. J. Bailey, " Lucydale " Stud, East Greenmount
	S. Cochrane, " Stanroy " Stud, Felton
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	G. Handley, " Handleigh " Stud, Murphy's Creek
	J. L. Handley, " Meadow Vale " Stud, Lockyer
	R. G. Koplick, " Melan Terez " Stud, Rochedale
	H. V. Littleton, " Wongalea " Stud, Crow's Nest
	O'Brien and Hickey, " Kildurham " Stud, Jandowae East
	E. Pukallus, " Plainby " Stud, Crow's Nest
	G. C. Traves, " Wynwood " Stud, Oakey
	E. Tumbridge, " Bidwell " Stud, Oakey
	Westbrook Farm Home for Boys, Westbrook
	H. W. Wyatte, Rocky Creek, Yarraman
	H. M. State Farm, " Palen Creek," Palen Creek
Large White	H. J. Franke and Sons, " Delvue " Stud, Cawdor
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	F. L. Hayward, " Curyo," Jandowae
	J. A. Heading, " Highfields," Murgon
	K. B. Jones, " Cefn " Stud, Pilton
	R. G. Koplick, " Melan Terez " Stud, Rochedale
	R. Postle, " Yaralla " Stud, Pittsworth
	E. C. Smith, " Smithfield " Stud, Coomera
	E. J. Bell, " Dorne " Stud, Chinchilla
	A. G. Fry, " Birubi " Stud, Dalby
Tamworth	S. Kanowski, " Miecho " Stud, Pinelands
	N. R. Potter, " Actonvale " Stud, Wellcamp
	D. F. L. Skerman, " Waverley " Stud, Kaimkillenbun
	A. C. Fletcher, " Myola " Stud, Jimbour
Wessex Saddleback ..	W. S. Douglas, " Greylight " Stud, Goombungee
	D. Kay and P. Hunting, " Kazan " Stud, Goodna
	E. Sirett, " Iona Vale " Stud, Kuraby
	C. R. Smith, " Belton Park " Stud, Nara



The Technique of Breast Feeding.

CONTRIBUTED BY THE DEPARTMENT OF HEALTH AND HOME AFFAIRS.

WE assume that your infant son or daughter has arrived safely and that he is beginning to take an interest in his food, which he hopes, and we hope, is going to be his mother's milk.

For your first ten days in hospital you won't have to worry much about his feeding, for the nursing staff will instruct you in the art and regulate it for you both.

However, it is unfortunate that most hospitals have a separate nursery for the babies, for it is most desirable that in the newborn period your baby should be close to you as much as practicable and not deposited in a nursery, except at certain fixed feeding times. It is too often the case that mothers return home without having had any real opportunity of getting to know their baby, or recognizing whether he is crying because he is hungry, or wet, or cold, or too hot, or troubled with wind, or requires his position changing, &c. The danger is that, when you get home and have to assume the responsibilities of housekeeping again, in addition to caring for your new baby, you will start worrying (often unnecessarily). You may get harassed and tired and unfortunately your milk supply may decrease for a time. But this temporary falling-off in your supply, if it should occur, may easily be overcome by judicially complementing some of baby's feeds, if he is short fed, until your supply increases again, which it assuredly will if the proper steps are taken.

Whatever you do, don't wean your baby in the mistaken assumption that your milk has gone for good. It is a mistake, also, to over-complement the feeds. Complementary feeds, if given unnecessarily, are apt to reduce the baby's desire for the breast and so to reduce the emptying of the breast, which is the best stimulus to the further production of breast milk. You should always let baby empty one breast before putting him to the second breast, and if he does not empty it completely the remaining milk should be expressed by hand and given to baby in a spoon or bottle. Remember, too, to start the baby on alternate breasts at each feed. And, of course, if baby is not getting quite enough he should be on (approximately) 3-hourly feeding, that

is, six feeds in the day in preference to 4-hourly (five feeds in the day), for this provides extra stimulus to the breasts and gives baby more food in the twenty-four hours.

Subsequent Feeding Regime.

Once the initial period of adaptation and mutual education between your baby and yourself has been successfully accomplished, things should settle down into more or less easy routine. But one of the errors to be guarded against is the adoption of too rigid a regime.

One of the commonest causes of excessive crying is a rigid feeding schedule which takes no note of the individual baby. It is irrational to feed your baby strictly by the alarm clock. Such a method presupposes that babies are not individuals but are all alike. It presupposes that they have the same stomach emptying time, the same temperament, and the same degree of activity. This is not so; there is a considerable individual variation in the time in which the stomach empties and hunger pains occur in different babies, whilst emotional factors, sleep, activity, and temperature may influence their time of appearance in the same baby.

It is only reasonable, therefore, that you should use considerable elasticity in the feeding schedule and that you should adjust it as far as possible to the needs of your child. You should not have to waken your baby for a feed unless it is premature or weakling and not thriving. The smaller the baby the more often it is likely to want to be fed. You should not give unnecessary fluids between feeds because it is crying for food; instead, you should adjust the frequency of the feeds to the baby's requirements. It may be necessary to feed the baby in the night in the first month or two when he wants it. Refusal to do this is a potent cause of excessive crying and of loss of sleep to mother and father.

Rigidity in the duration of the feed is another cause of excessive crying; ten minutes at each breast is an average guide only. Those who advocate a fixed time on the breast presuppose that all babies suck at the same speed and that all breasts are the same. The duration of the feed is an individual matter and you will learn by experience how long your baby requires at the breast to satisfy his needs. A cardinal rule is never to force your baby to take the breast when he does not want it. A very common cause of wind and colic is leaving the baby to suck too long on the breast. When the breast is empty, suckling inevitably causes air swallowing. But on the whole your baby is the best judge of how much food it needs and when it wants it.

In the course of the first few weeks it will usually be found that the number of times that your baby sleeps for four hours between feeds gradually increases and that he can thus slide into a four-hourly programme rather than be forced into it. No hard and fast rule can be given as to when the night feed can be omitted, but a normal robust baby should soon learn to sleep right through the night, and it would then of course be folly to waken him for an extra feed. It is obviously a great advantage to the mother (not to mention the father) when she can get six or more hours undisturbed sleep.

For practical purposes, then, the feeding regime should be regarded as a compromise between the baby's demand to have the breast immediately available when it desires food or comfort, the baby's need of intervals between feeds for sleep, digestion and emptying of the stomach, and the mother's need for rest, exercise, and time for the secretion of a fresh milk supply by the breasts after nursing.

ASTRONOMICAL DATA FOR QUEENSLAND.

JUNE.

Supplied by W. J. NEWELL, Hon. Secretary of The Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			Minutes later than Brisbane at other places.					
Day.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	6·30	5·00	Cairns	8	50	Longreach ..	26	43
6	6·32	5·00	Charleville	25	29	Quilpie	37	33
11	6·34	4·59	Cloncurry	36	63	Rockhampton ..	1	19
16	6·36	5·00	Cunnamulla ..	31	27	Roma	15	19
21	6·38	5·00	Dirranbandi ..	22	16	Townsville ..	8	42
26	6·39	5·02	Emerald	11	28	Winton	29	52
30	6·39	5·03	Hughenden ..	21	49	Warwick	5	3

TIMES OF MOONRISE AND MOONSET.

At Brisbane.

Day.	Rise.	Set.
	a.m.	p.m.
1	3·11	2·30
2	4·07	3·03
3	5·03	3·40
4	6·00	4·22
5	6·56	5·08
6	7·49	5·59
7	8·38	6·53
8	9·22	7·49
9	10·01	8·46
10	10·37	9·42
11	11·09	10·38
12	11·38	11·34
13	p.m. 12·08	..
14	12·39	a.m. 12·31
15	1·11	1·31
16	1·49	2·34
17	2·33	3·42
18	3·26	4·54
19	4·28	6·06
20	5·38	7·15
21	6·50	8·17
22	8·02	9·08
23	9·10	9·51
24	10·13	10·28
25	11·12	11·01
26	..	11·31
27	a.m. 12·10	p.m. 12·01
28	1·06	1·32
29	2·02	1·04
30	2·58	1·40

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

Charleville 27; Cunnamulla 29; Dirranbandi 19;
Quilpie 35; Roma 17; Warwick 4.

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Day.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	14	25	30	41	5	16	34	47
6	9	30	25	45	0	21	26	54
11	14	23	30	39	5	14	34	45
16	26	14	42	29	17	4	49	33
21	29	10	45	24	20	0	52	27
26	17	19	33	36	8	10	37	41
30	12	28	27	43	2	19	30	52

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	18	42	42	59	27	44	16	36
3	9	51	37	64	21	50	8	43
5	2	56	33	67	17	53	3	46
7	2	55	33	67	17	52	3	45
9	9	47	37	62	21	47	8	39
11	18	38	42	56	27	41	16	33
13	28	27	50	48	34	33	24	23
15	40	22	57	45	42	30	33	19
17	51	9	65	36	49	22	42	9
19	56	2	68	32	52	17	46	3
21	53	4	67	33	50	19	44	5
23	42	13	58	39	43	24	35	13
25	30	25	51	47	35	32	25	22
27	25	36	47	55	32	40	21	31
29	14	46	39	61	24	47	13	38
30	10	50	37	63	22	49	9	42

Phases of the Moon.—New Moon, 5th, 2.40 a.m.; First Quarter, 13th, 4.52 a.m.; Full Moon, 19th, 10.36 p.m.; Last Quarter, 26th, 4.21 p.m.

On June 22nd at 3 p.m. the sun will reach its greatest angle north of the equator. It will then rise and set approximately 25 degrees north of true east and true west respectively.

On the 13th and 26th the moon will rise and set very close to true east and true west respectively.

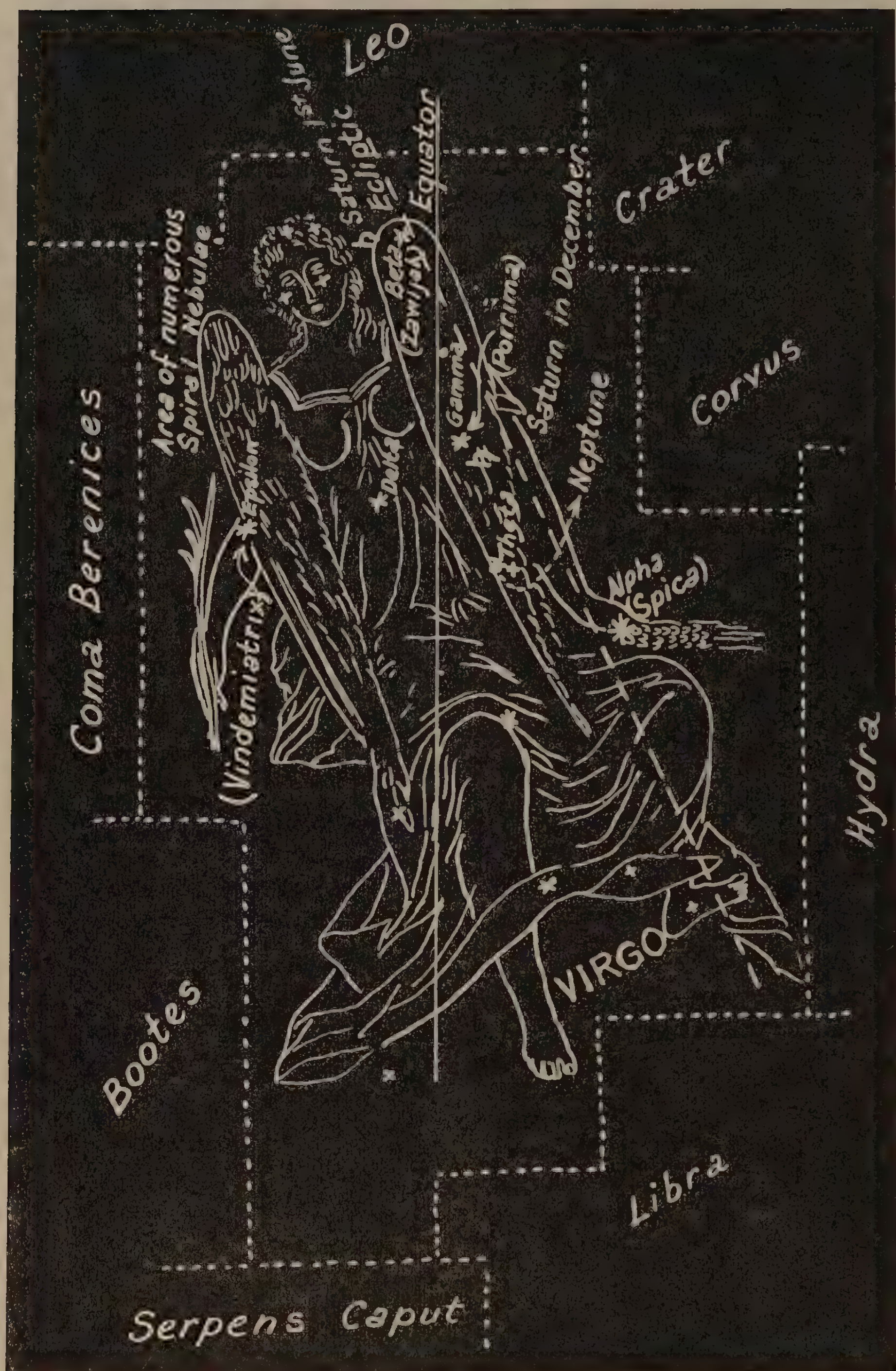
Mercury.—A morning object at the beginning of the month in the constellation of Aries, when it will rise about 1¾ hours before the sun. On the 25th it will be in line with the sun, after which it will become an evening object and at the end of the month, in the constellation of Gemini, will set 21 minutes after sunset.

Venus.—In the constellation of Gemini, near Castor and Pollux, at the beginning of the month, when it will set 3 hours after the sun. After passing through the constellation of Cancer, on the 25th in the Constellation of Leo it will reach its greatest angle east of the Sun and set 3½ hours after sunset.

Mars.—Still too close in line with the sun for observation.

Jupiter—In the constellation of Pisces, will rise between 1.45 a.m. and 3 a.m. at the beginning of June and between midnight and 1 a.m. at the end of the month.

Saturn.—In the constellation of Virgo, will be nearly overhead at nightfall, on the 1st setting soon after midnight and at the end of June setting just before midnight.



THE CONSTELLATIONS.

In the past few months the constellations close to the South Celestial Pole have been described and because they are above the horizon for such long periods they have been dealt with in a manner which readily shows their relationship to one another; no attempt has been made to publish the descriptions to coincide with the time of the constellations' most favourable appearance in the sky. As we move away from the Pole, however, the constellations have marked seasons for favourable observation and publication will agree with these periods.

With this object in view we leave the region of Orion, etc., and introduce Virgo—the large Zodiacal Constellation covering part of both the celestial equator and the ecliptic. It is said to represent Proserpine, the daughter of the Goddess Ceres, known as the Earth's mother. It is shown in old star maps as a virgin with a wheat-ear in her hand presiding over the harvest. It is also shown to represent the Goddess of Justice and Purity. The sun passes through the constellation from the end of September to the end of October and crosses the Celestial Equator about 23rd September. In June it rises during the afternoon daylight hours and is well up at nightfall, crossing the meridian soon after 7 p.m. Its brightest star is Spica (Alpha Virginis), a pure white 1st mag. star which is very hot. It is also a binary, the stars revolving about a common centre of gravity in about 4 days. Gamma is also a binary, with a period of 180 years, the stars being of 3rd magnitude and six seconds apart. A 4th magnitude star, Theta, has a 9th magnitude companion. The area round Epsilon, Delta, Gamma and Beta contains hundreds of spiral nebulae, but require the aid of a telescope to bring them to view. At the present time Saturn is in the constellation and will remain so throughout the year, passing from west to east of Beta and occupying a position near Gamma at the end of 1951. Venus and Mars will also enter Virgo during November. The position of Neptune, which is not visible to the naked eye and changes its position very little from year to year, is shown on the sketch.

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JUNE, 1951

DEPARTMENT OF AGRICULTURE

QUEENSLAND AGRICULTURAL JOURNAL

Ready for the Sheari

LEADING FEATURES

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Russian Knapweed

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Economics of Milk Production

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Edited by
C. W. WINDERS, B.Sc.Agr.

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MINISTER FOR AGRICULTURE AND STOCK

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11

Contents

Potato Culture in Queensland.*

W. J. CARTMILL (Chief Soil Conservationist†) and
W. H. BECHTEL (Chief Adviser in Agriculture).

POTATOES can be grown successfully in many districts in Queensland, but a close study of local conditions is necessary to ensure success. For best results the crop requires cool growing conditions, an ample supply of moisture, and a fertile, friable soil. Because the rainfall in Queensland is light during the cooler periods of the year the crop is mostly grown under irrigation. With the expansion of irrigation practices in recent years there has been a corresponding expansion in potato production in the State. For example, the average annual production for the 10-year period ending 1937 was 17,150 tons, whereas for the 5-year period ending 1949 the annual average was 29,050 tons. To supply the between-season requirements it is necessary

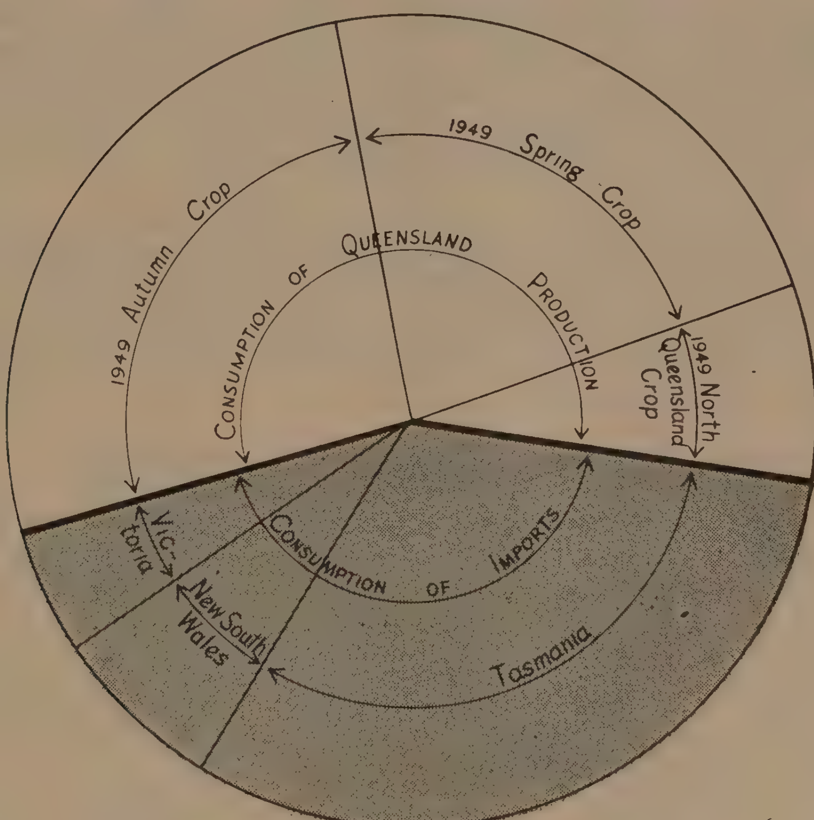


Plate 184

Diagram Showing Commercial Production and Consumption of Potatoes in Queensland for the Year Ended 31st March, 1950.

* This is a revision and enlargement of articles by C. J. McKeon which appeared in this Journal some years ago.

† Formerly Senior Soils Technologist.

to import from other States, and for the 5-year period ending 1949 importations averaged 26,100 tons annually. Commercial production and consumption for 1949-50 are shown diagrammatically in Plate 184.

The main potato growing districts are located in the south-eastern portion of the State. During World War 2, however, considerable expansion occurred in the Lower Burdekin and present production in this area makes a significant contribution to the State's requirements.

Where soil and climatic conditions are suitable, and provided sound cultural methods are adopted, good financial returns can be obtained from potato growing. In Queensland, wholesale marketing of locally grown potatoes is organised by the State Potato Marketing Board acting on behalf of the growers.

TIME OF PLANTING.

Growers in most potato growing districts are fortunate in being able to produce two crops a year. The first of these, commonly known as the spring crop, is planted in August; the second, known as the autumn crop, in February. In some districts which enjoy a partial immunity from frosts, plantings are carried out in July so that the crop can benefit by the cooler temperatures during its growing period. The main spring crop planting, however, is carried out during August, although in districts such as the Darling Downs, planting may be delayed as late as September due to the risk of late frosts injuring earlier plantings.

It is generally recognised that the earlier the spring crop is planted the greater are the chances of a heavy yield, provided, of course, that weather conditions are favourable. A crop planted late in spring may encounter high temperatures and humid weather and tend to produce excessive top growth and a light crop of tubers. Similar unsatisfactory results may follow the use of an unsuitable variety.

In North Queensland, where only one crop is grown annually, the time of planting is influenced by the incidence of the monsoonal rains, and planting there does not take place until the wet warm season is over, usually in April-May. Sometimes a prolonged wet season will delay planting till June or even July. Late plantings, however, are not favoured.

SUITABLE SOILS AND ROTATIONS.

Potatoes can be grown satisfactorily on almost any well-drained soil of reasonable fertility, but the crop thrives best on deep, fertile loamy soils containing adequate quantities of organic matter. The function of the organic matter is to supply soil humus, which, as well as providing plant foods, has a beneficial effect on the structure or tilth of soils, particularly of heavy soils, keeping them loose, open, friable, and permeable to water. Organic matter greatly improves the water-holding capacity of light soils.

Heavy clay soils and soils which are badly drained and liable to become waterlogged should be avoided for potatoes, as not only are the chances of raising a crop very limited on such soils, but tubers of good shape and quality cannot be produced on them. Even on the best soils, high yields cannot be maintained if potatoes are grown continuously for a number of years unless care is taken to preserve the physical condition of the soil by keeping up the supply of humus.

Loss of humus can be minimised by practising a rotation of crops, and the supply in the soil can be maintained to a large extent by regular additions of large quantities of organic matter—for example, by ploughing in bulky green manures and cover crops and by using liberal quantities of farmyard manure where it is available. The green manure crop which should form part of the planned rotation, and preferably precede the potato crop, should be based on a legume such as field pea for winter growth or cowpea for summer growth. The former can be sown mixed with wheat, oats, or barley and the latter with maize, millet, or Sudan grass to increase the bulk of organic matter to be turned under.

Farmyard manure and leguminous green manures possess considerable value as fertilizers in addition to supplying organic matter. It should be realised, however, that green manures alone will not restore the humus to soils depleted by intensive cropping over a number of years or restore the desirable loamy structure or tilth so characteristic of most virgin soils. This condition can only be achieved by turning the area into grassland for a period of preferably not less than two years. A dense, vigorous cover of grass will do much to restore the soil to a state of virgin productivity. The fact that potatoes produce high yielding crops on well prepared friable virgin land, in which there is a good supply of organic matter, is due in large measure to the good physical condition of the soil resulting from the satisfactory humus content.

FERTILIZERS AND LIME.

The purpose of using artificial fertilizers is simply to correct deficiencies of major plant foods in the soil. They do not make up for other deficiencies such as a lack of organic matter or humus, improper preparation or insufficient cultivation of the soil, poor drainage and lack of soil moisture. Nevertheless, the soil must be adequately supplied with the necessary nutrients to obtain satisfactory yields, for the potato is a gross feeder and makes heavy demands on the plant food reserves of the soil.

The three major plant nutrient elements supplied in artificial fertilizers are nitrogen, phosphorus and potassium, and it is only when the soil contains insufficient of one or more of these elements for the adequate nutrition of the potato crop that artificial fertilizers can have any beneficial effect. The kind and amount of fertilizer required vary with the locality because of the differences in composition of the various soil types.

Attention is drawn to the fact that ploughing under a well grown, heavy yielding, leguminous green manure crop some five or six weeks prior to planting potatoes will supply most, if not all, of the additional nitrogen required for the potato crop.

Lockyer and Fassifern Valleys.

In the Lockyer and Fassifern Valleys, potatoes are grown on alluvial soils of inherently high fertility (Plate 185). Nevertheless, beneficial responses are frequently obtained from applications of sulphate of ammonia at the rate of 2-3 cwt. per acre, and on some of the lighter soils up to 4 cwt. per acre may be profitably used. No other fertilizer is required for these soils in general, although some of the heavier soils in the lower Lockyer and Laidley Creek Valleys are deficient in potassium and may benefit by applications of sulphate of potash or muriate of potash at 1-2 cwt. per acre. All the soils have ample supplies of available phosphorus, and phosphatic fertilizers are not required.

Plate 185.

A Field of Potatoes at Minden, in the Lockyer Valley.

Lower Burdekin.

From the evidence of field trials the alluvial soils of the Lower Burdekin appear to be mainly deficient in nitrogen, and applications of sulphate of ammonia to these soils at the rate of 3-4 cwt. per acre can confidently be expected to give a profitable response.

Other Areas.

The alluvial soils of the Logan and Albert River Valleys are fairly fertile but, like the soils of the Lockyer Valley, would probably show responses to sulphate of ammonia at 2-3 cwt. per acre.

Many of the red volcanic soils of the South Burnett and Atherton Tableland districts are deficient in nitrogen and available phosphorus, and frequently also in available potassium. It is advisable to use a complete fertilizer mixture for potatoes on these soils A mixture with the approximate formula 8:10:5 applied at 3-5 cwt. per acre is recommended for general use.

On some of the alluvial flats in the South Burnett, potassium may be the chief plant food deficient in the soil, and in these places it may be necessary to use only sulphate of potash or muriate of potash at 1 cwt. per acre after a leguminous green manure crop has been ploughed under.

For the lighter textured alluvial soils of the Brisbane Valley, a mixture of equal parts of sulphate of ammonia and superphosphate (or a 10:10:0 mixture) at 3-5 cwt. per acre is recommended.

On other areas where the soils are not inherently fertile and are known to require fertilizer, a complete mixture with the approximate formula 8:10:5 should be applied at 3-5 cwt. per acre.

Application of Fertilizers.

The fertilizer is usually applied in the furrow or drill at planting time. The normal method is to drill in the fertilizer prior to planting the seed, but more efficient utilization of the fertilizer can be secured if it is placed in a band a few inches to the side of the seed and covered by the soil without mixing. The potato setts should not be placed in direct contact with the fertilizer because of the risk of injury to the germinating seed.

The greatest benefits from applications of nitrogenous fertilizer, such as sulphate of ammonia, are usually obtained when half the fertilizer is applied at planting time and the remainder put on as a side dressing at the early flowering stage of the crop.

Lime.

Potatoes grow best in slightly to moderately acid soils but can tolerate a fairly wide range of soil acidity. As most of the potato soils in this State are either moderately acid to neutral in reaction, lime is not generally required. Its use may not only decrease the yield but may also increase the incidence of potato scab. Only under very acid conditions, such as occur in peaty soils or in some soils in heavy rainfall areas, would the use of lime be warranted.

PREPARATION OF THE SOIL.

Early and thorough preparation of the soil is essential if the best results are to be obtained from any crop, but to none does this apply more so than to potatoes. Farmers who spend the extra time and labour required to bring the soil into first-class condition will be more than repaid by the improved yields obtained, especially if a dry spell is experienced during the growth of the crop. Under the most favourable conditions, good crops may be produced on land that has received a hurried and rough preparation, but in any district such conditions are likely to occur only at rare intervals, and consequently the necessity for thorough preparation of the land cannot be too strongly stressed.

The first ploughing should be to a depth of at least nine inches, which will ensure that the seed, when planted, will have four inches of worked soil beneath it. The land should be left fallow for at least two months before planting, care being taken during that time to deal with any weed growth which may appear. A fallow period of two months or more is particularly important where a non-leguminous cover crop has been turned under. Sufficient time must be allowed for the cover crop residues to rot adequately, otherwise undecomposed organic matter may cause a temporary shortage of soil nitrogen available for plant growth. This will result in stunting and yellowing of the following potato crop. The use of a spring tooth cultivator or other suitable implement will not only deal with weed growth but will ensure that the surface soil is in good condition.

Land prepared in this way should at planting time be in satisfactory condition to give a good germination if reliable, selected seed is used. If the practice of ploughing in the seed is not adopted, the land should receive a second ploughing, which should be at least three inches shallower than the first, just prior to planting.

TABLE I.

VARIETAL CHARACTERISTICS OF POTATO TUBERS.

Name of Variety.	Maturity.	Shape of Tuber.	Colour of Skin.	Texture of Skin.	Formation of Eyes.	Number of Eyes.	Placement of Eyes.	Colour of Sprouts.
Factor	Mid-late	Elongated oval	White	Fine, smooth	Shallow set. Pronounced eyebrow	Moderate	Mostly apical	Green
Carman	Mid-early	Oval	White	Fine, netted	Shallow set. Faint eyebrow	Moderate	Evenly distributed	Green
Bismark	Early	Elongated oval	Creamy white	Fine, smooth	Shallow set. Pronounced eyebrow	Numerous	Evenly distributed	Purple
Katahdin	Early	Rounded, flat	White	Fine, smooth	Shallow set. Faint eyebrow	Few	Apical	Green
Delaware	Mid-early	Long, flat	Creamy white	Fine, smooth	Shallow set. Faint eyebrow	Numerous	Evenly distributed	Green
Brownell	Mid-early	Round	Brownish-red	Fine, netted	Deep set. Faint eyebrow	Few	Evenly distributed	Pink
Manhattan	Mid-early	Elongated oval	Purple blotched	Coarse, smooth	Deep set. Very pronounced eyebrow	Numerous	Evenly distributed	Purple
Early Manhattan	Early	Round	Purple	Coarse, netted	Deep set. No eyebrow	Moderate	Evenly distributed	Purple
Guyra Blue	Mid-early	Elongated oval	Purple	Fine, smooth	Deep set. Very pronounced eyebrow	Numerous	Evenly distributed	Purple
Satisfaction	Early	Round	Pink	Fine, smooth	Deep set. Faint eyebrow	Few	Mostly apical	Pink
Sebago	Mid-late	Flat, oval	White	Fine, smooth	Shallow set. Pronounced eyebrow	Moderate	Evenly distributed	Pink
Sequoia	Mid-late	Flat, oval	Creamy white	Fine, smooth	Shallow set. Faint eyebrow	Few	Mostly apical	Green
Saranac	Mid-early	Round	White	Fine, netted	Deep set. Eyebrow absent	Few	Mostly apical	Green
Adina	Late	Rounded, oval	White	Fine, netted	Shallow set. Pronounced eyebrow	Few	Mostly apical	Green
Monak	Late	Round	White	Fine, netted	Shallow set. Faint eyebrow	Few	Mostly apical	Green
Moona	Mid-late	Oval	White	Fine, smooth	Shallow set. Faint eyebrow	Few	Mostly apical	Green
Exton	Late	Rounded, flat	White	Fine, smooth	Shallow set. Faint eyebrow	Few	Mostly apical	Pink
Symington	Early	Round	Creamy white	Fine, netted	Deep set. Faint eyebrow	Few	Evenly distributed	Red
Gold Coin	Early	Round	Ivory white	Fine, smooth	Deep set. Faint eyebrow	Few	Evenly distributed	Pink
Pontiac	Very early	Round	Brown	Fine, smooth	Shallow set	Moderate	Evenly distributed	Red
Dakota Red	Early	Round	Reddish brown	Fine, netted	Deep set. Faint eyebrow	Moderate	Evenly distributed	Red

NOTE.—The potato responds readily to the influence of environmental conditions; consequently there is much variability in many characters.

VARIETIES.

The question of the most suitable variety to grow is one which the farmer will have to decide for himself, either as the result of his district's experience of potato varieties or after consultation with an appropriate Departmental officer.

The general characters of the better known varieties grown in this State are set out in Table 1. Of these the first eight—Factor, Carman, Bismark, Katahdin, Delaware, Brownell and Manhattan types—are older varieties. Among the newer varieties are Sebago, Sequoia, Saranac, Adina, Monak, Moona and Exton.

Factor (Plate 186) is by far the most widely grown of the white-skinned varieties. It is adaptable to a wide range of soil and climatic conditions and produces a high yield of tubers of good size and quality. Although it is still the standard variety in most districts it is gradually being displaced by varieties less prone to disease and second growth.

Up-to-Date is similar to Factor, which is commonly regarded as a strain of Up-to-Date.

Carman (Plate 187) is a popular variety because of the excellent quality of the tubers. However, it requires specially favourable conditions to give satisfactory yields and has largely been displaced by higher yielding varieties.

Bismark (Plate 188) is a variety which yields well, but its susceptibility to second growth and the tendency to produce a high percentage of misshapen tubers are serious disabilities. It is resistant to the virus causing leaf roll. This variety is in popular demand in the Lower Burdekin.

Katahdin (Plate 190) was bred in America to resist virus diseases generally, but more particularly mosaic. It produces good yields under favourable conditions and does not make second growth. It is fairly resistant to leaf roll.

Delaware (Plate 189) is not a favoured variety in Queensland and its cultivation is mainly confined to small plantings in the South Burnett. It is a creamy white, smooth skinned variety with numerous, shallow-set eyes.

Tasmanian Brownell (Plate 191) has a rough red skin and stores well. It is not widely grown in Queensland. *Satisfaction* (Plate 192) is closely related to Tasmanian Brownell.

Early Manhattan (Plate 194) is a popular purple-skinned potato which possesses hardiness and good keeping qualities, and can be grown over a fairly extensive range of soil and climatic conditions. Its tubers are set deeply and consequently are not very susceptible to moth infestation in the field.

Sebago (Plate 195) is increasing in popularity. It is a good yielding variety and produces a high proportion of marketable tubers. It possesses resistance to Irish blight and is not prone to make second growth.

Sequoia (Plate 196) can tolerate fairly dry conditions and is a suitable variety for non-irrigated areas. It produces a very high percentage of marketable tubers, which under favourable conditions may be very large. It is resistant to Irish blight.

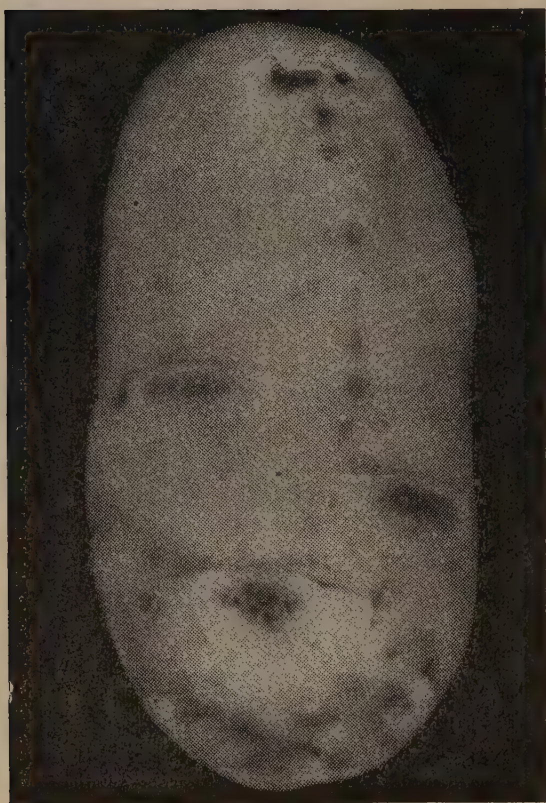


Plate 186.
Factor.

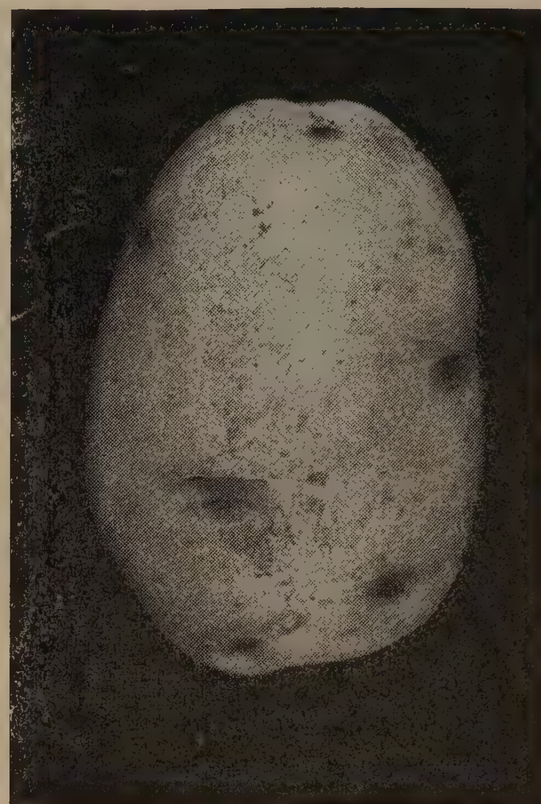


Plate 187.
Carman.

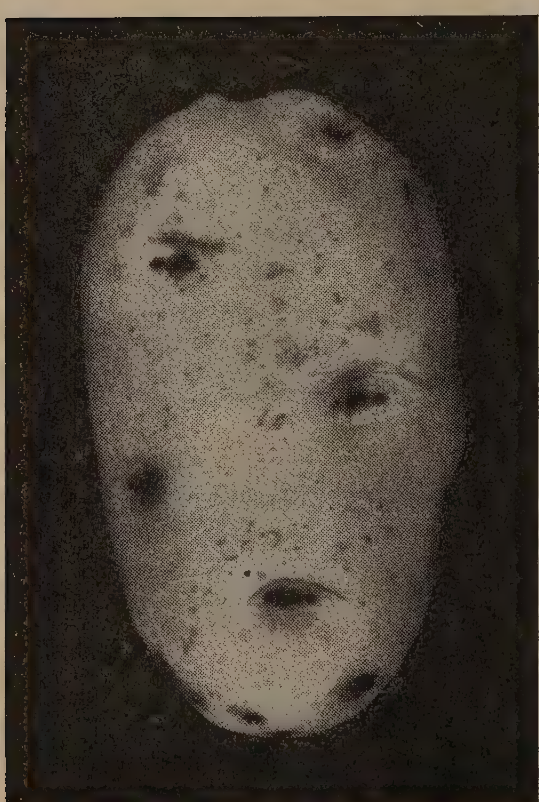


Plate 188.
Bismark.

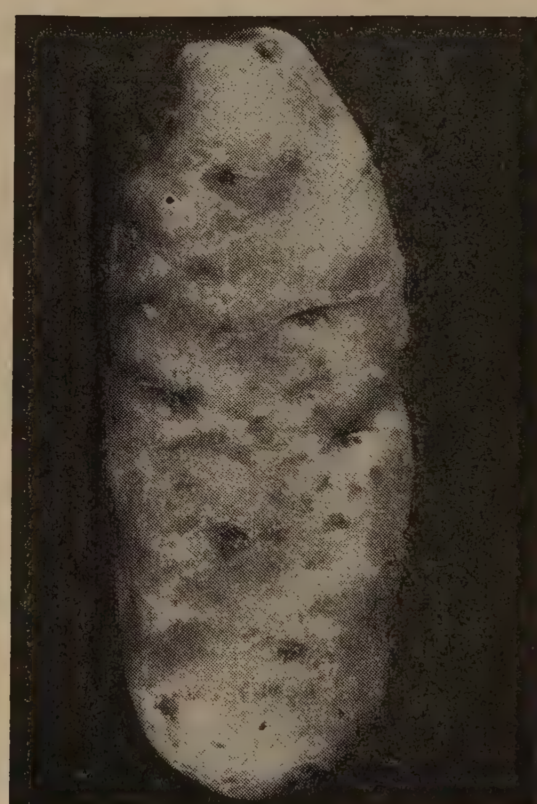


Plate 189.
Delaware.

Plate 190.
Katahdin.

Plate 191.
Brownell.

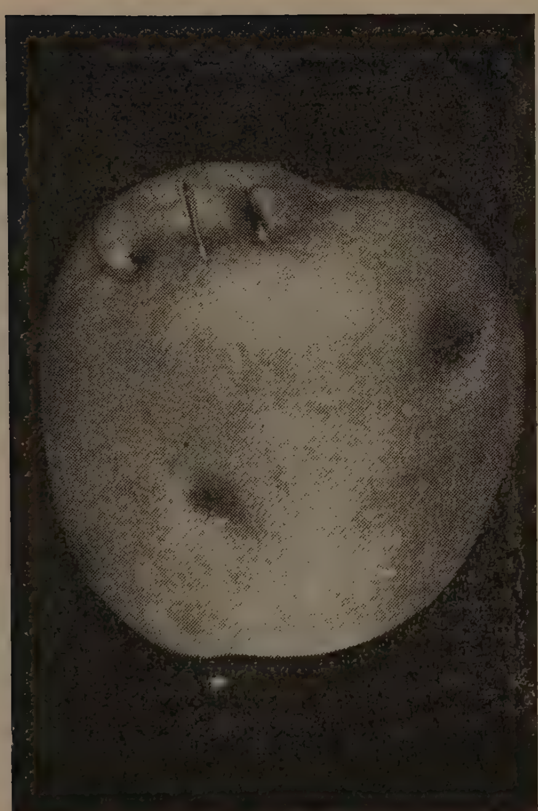


Plate 192.
Satisfaction.

Plate 193.
Manhattan.

Plate 194.
Early Manhattan.

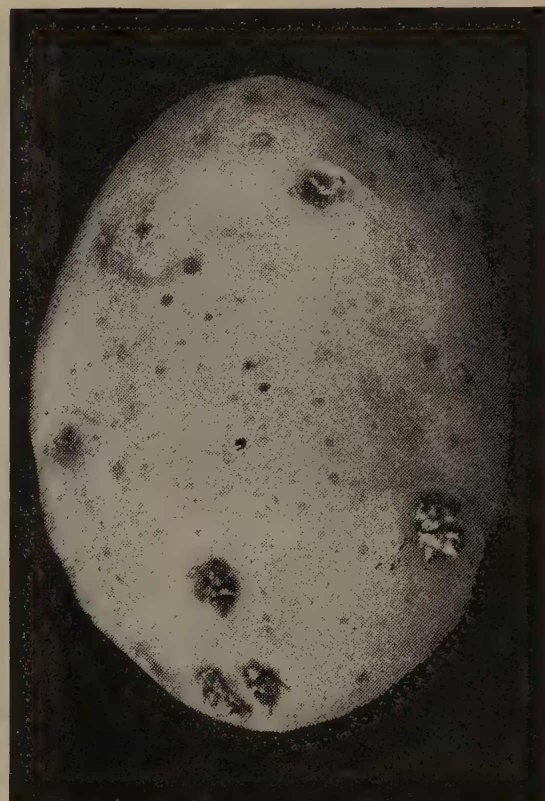


Plate 195.
Sebago.

Plate 196.
Sequoia.

Plate 197.
Saranac.

Plate 198.

Monak.

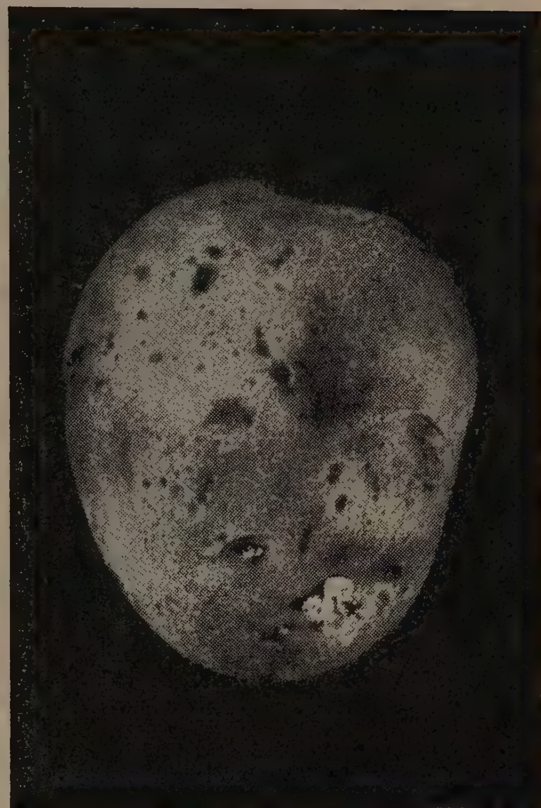


Plate 199.

Moona.

Plate 200.

Adina.

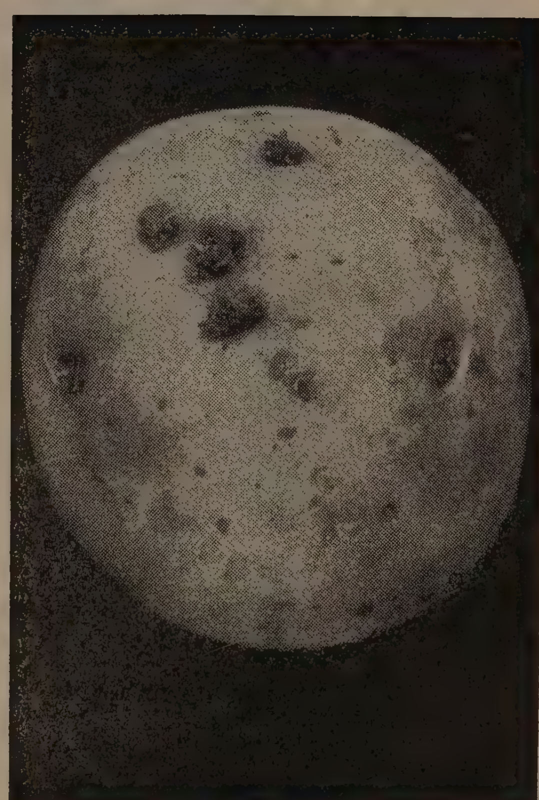


Plate 201

Exton.

Saranac (Plate 197) is not grown extensively, but in field trials has given good yields of first grade tubers.

Monak, Moona and Adina were bred at the New England Experiment Farm, Glen Innes, and released by the New South Wales Department of Agriculture in 1948. In field trials in New South Wales these varieties have consistently outyielded Factor.

Monak (Plate 198) yields a high percentage of first grade tubers of good quality. An important character is its field resistance to Irish blight and target spot. It also has some resistance to virus diseases and scab and appears to be fairly free from second growth.

Moona (Plate 199) produces medium sized tubers set closely under the plant. It has a fair degree of resistance to Irish blight, but is somewhat prone to second growth.

Adina (Plate 200) does best on the New South Wales tablelands and has limited use on the coast. Consequently it may not be adaptable to Queensland coastal areas. It has field resistance to Irish blight and target spot and is fairly free from second growth.

Exton (Plate 201) is a new variety from Victoria, where it was selected from a patch of Katahdin. It resembles the parent but is later maturing. It has been tested over a few years in Victoria and there have been favourable reports on its performance from New South Wales and South Australia. It possesses a fair degree of resistance to Irish blight.

SEED.

Seed has to be imported from the southern States for the spring planting in Queensland, as locally grown seed is unavailable for that crop. Every effort should be made to secure imported seed supplies which are certified as being produced from a disease free crop. It is far better to obtain first class seed, true to the name of the variety which is known to suit the locality in which the crop is to be grown, even though it may cost a little more, rather than to obtain a cheaper line of poor seed which may turn out to be anything but the desired variety. Certified seed should therefore be obtained if possible.

Provided the spring crop is planted early, seed can be obtained from it for planting the autumn crop in February. The grower should carefully select the tubers to be reserved for that purpose. Unfortunately, it is a common practice to use tubers which are the remains or culls from the crop after all marketable table tubers have been sold. Although they may be of a desirable size for planting the autumn crop, for which whole seed is generally used, it is an undesirable practice to use them and one which has the effect of reducing yields. Many of the tubers so selected for planting will almost certainly have been produced by weak or diseased plants which did not produce tubers of marketable size.

The general practice in the case of other important crops is to select seed only from the most desirable plants and the same care should be devoted to the selection of seed potatoes. Growers will be fully compensated for the extra time and labour involved in selecting their seed requirements only from healthy plants which produced a reasonable number of tubers, the majority of which were of good type and of marketable size. The tubers selected for seed purposes should be stored in a cool, well-ventilated room, and should be spread out in shallow

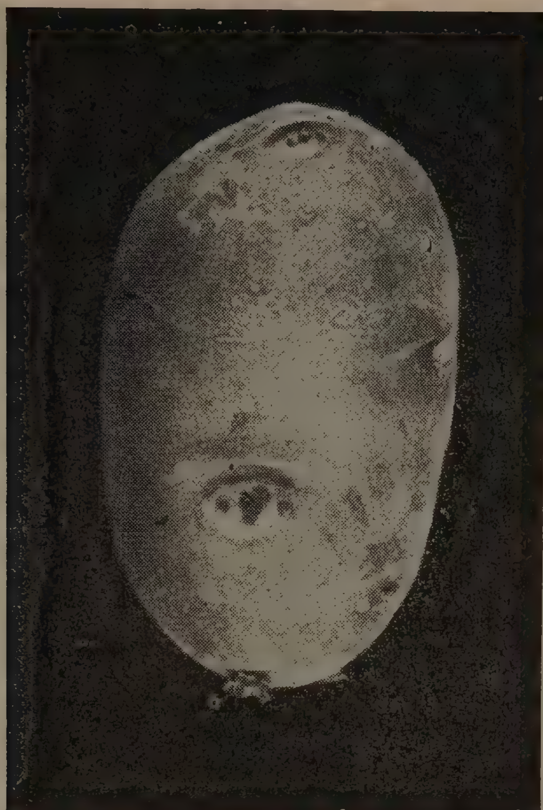


Plate 202.

Guyra Blue.

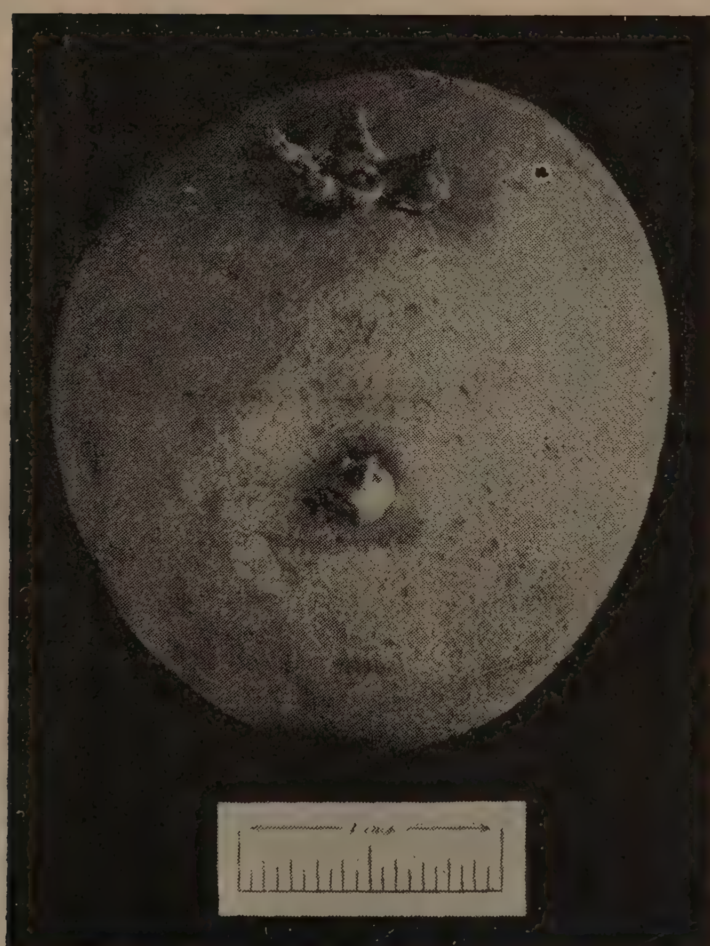


Plate 203.

Short, Sturdy Shoots, the Result of Exposure to Light.

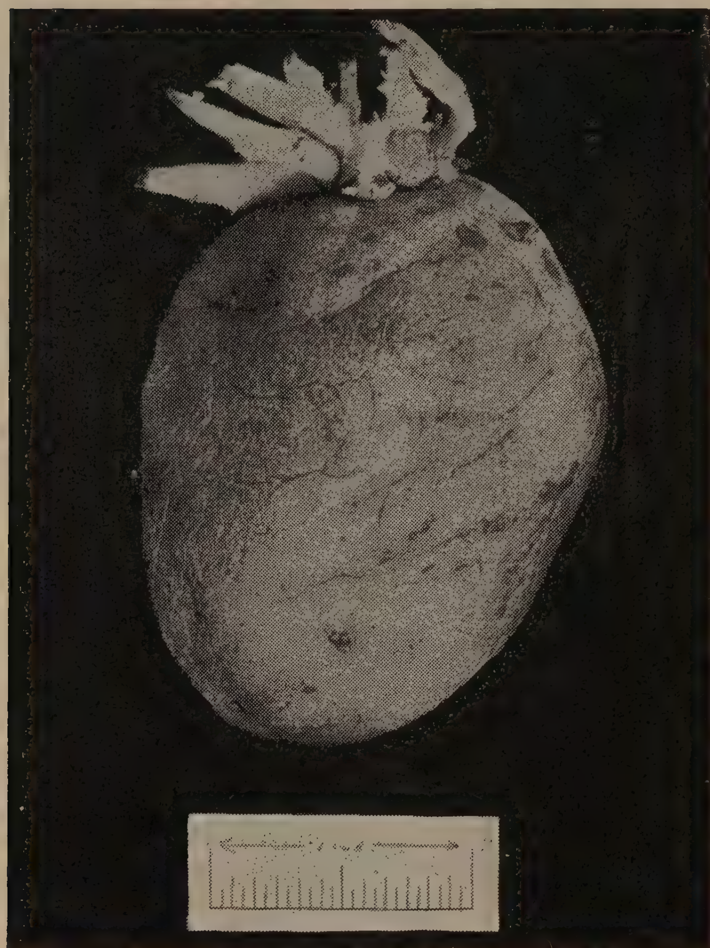


Plate 204.

Weak, easily Damaged Shoots, the Result of Insufficient Light.

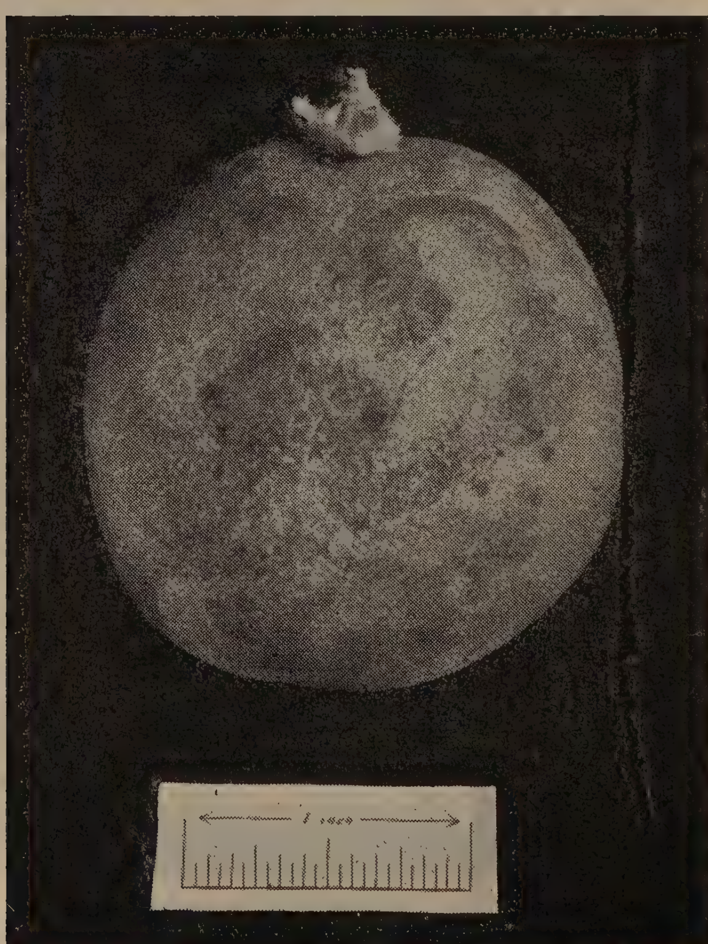


Plate 205.

An Ideal Single Sett.

layers to promote the development of short, sturdy shoots which will not rub off readily when handled and which will produce strong, healthy plants (see Plates 203-208). A further advantage of storing in this way is that the tubers are less likely to rot than when stored in heaps or deep layers and any which show signs of disease can readily be detected and immediately removed. Much greater difficulty is experienced in storing potatoes from the spring crop than is the case with the autumn crop owing to the fact that they require to be stored during the warmer months of the year when the potato tuber moth is likely to cause serious loss. Only sound, dry, unblemished potatoes should be stored, and these should be treated with a reliable insecticide before being set aside for storage.

Seed for the spring crop may be cut, but this practice is not advisable in the case of the autumn crop, as hot, wet weather is frequently experienced during February and consequently cut seed is likely to rot in the ground. When cut seed is used, the seed should be cut a day or two before planting in order to allow the cut surfaces to dry.

The best manner in which to cut seed potatoes will, in large measure, depend on their size, but as a general rule the smaller tubers should be cut in half lengthwise (Plate 206), and in the case of somewhat larger tubers the stem end should be cut off at about a third of the length of the tuber, the remaining portion being cut through the centre lengthwise, thus making three portions for planting (Plate 207). Still larger tubers should be cut into four setts of approximately equal size (Plate 208). Very large tubers may be cut into as many as six or eight setts. It is considered, however, that yields may be prejudiced if sett weight is reduced below 1½-2 oz. Any tubers which are not perfectly sound, or which, on being cut, show a suspicious looking discolouration, should be rejected.

Whether cut or whole seed is used, it is very desirable to plant only "shot" seed—that is, seed which has developed short, sturdy shoots. The planting of "unshot" seed is often responsible for uneven stands, irregular growth and low yields.

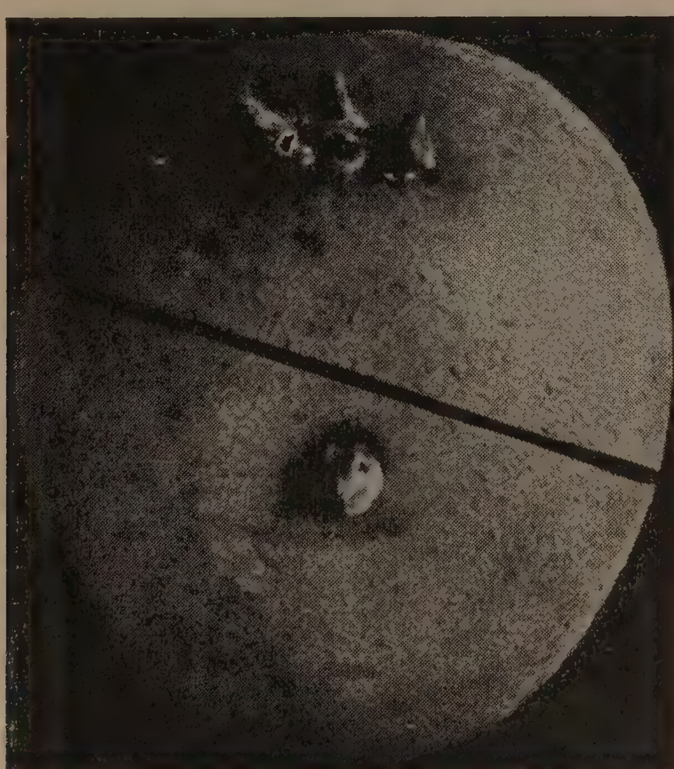


Plate 206.

Tuber Suitable for Cutting into Two Setts as Shown.

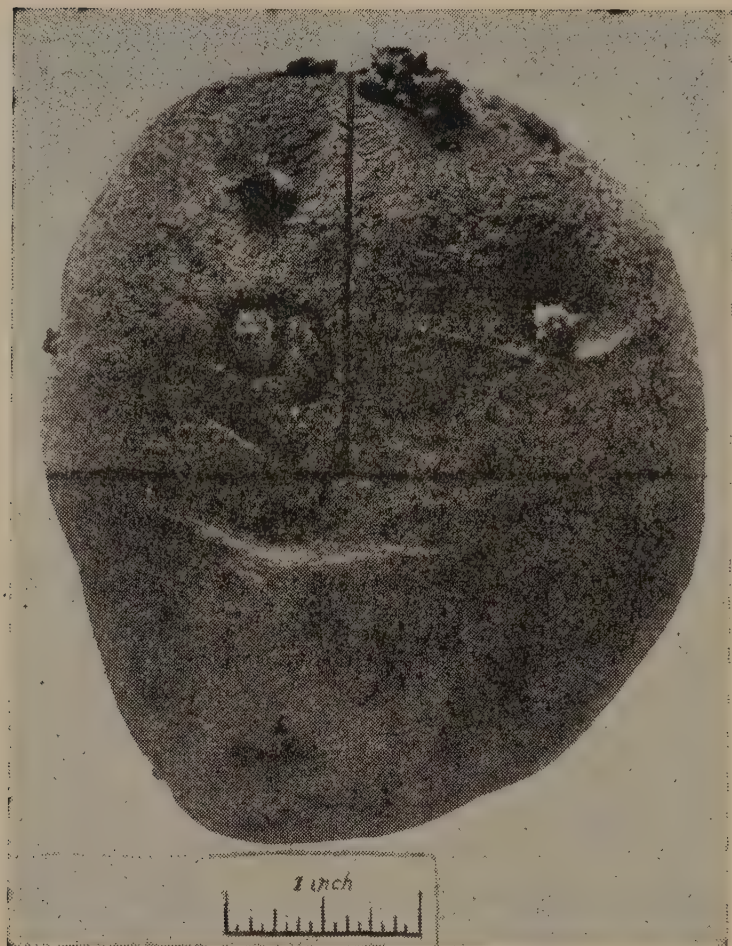


Plate 207.
Tuber Suitable for Cutting into Three Setts.

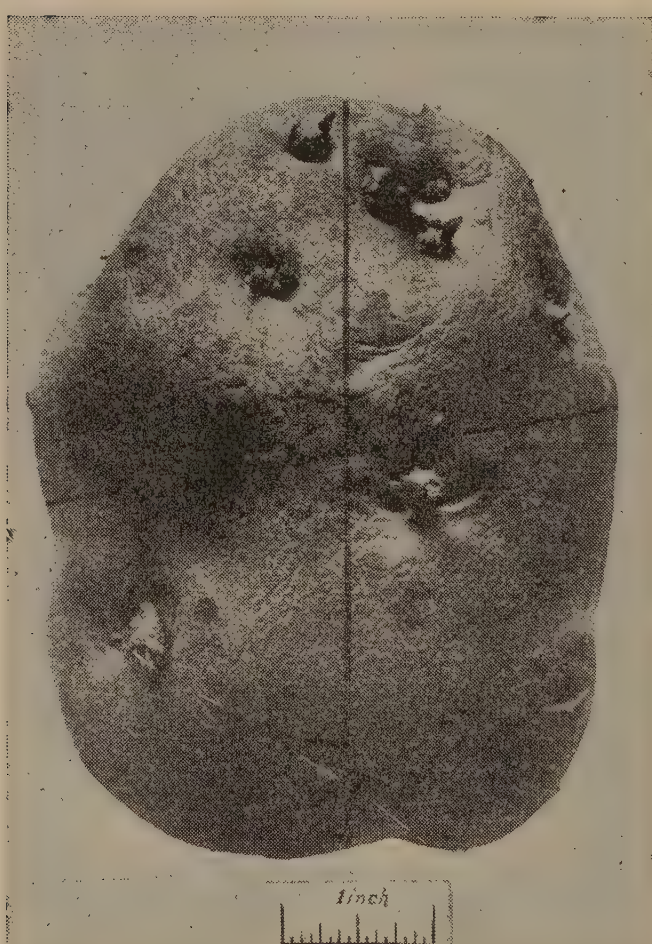


Plate 208.
Tuber Suitable for Cutting into Four Setts.

The quantity of seed required to plant an acre depends on the size of the seed and on whether whole or cut seed is used. On the average 7-10 cwt. of seed potatoes will suffice.

BREAKING THE DORMANCY OF POTATOES.

Various chemicals are known to be capable of breaking dormancy in potatoes but the cost of most of them would be prohibitive under commercial conditions. The use of acetylene gas, however, offers a method which is reasonably cheap and has been claimed to be effective. No investigations along these lines have been carried out in Queensland and the method has not been widely used here. For interested farmers the following is a summary of the details involved in the acetylene method of inducing sprouting in potatoes. With a little modification the method can be adopted for commercial usage.

Half fill a container with water and add gradually, over a period of a quarter of an hour, small pieces of commercial calcium carbide. The object of adding the carbide slowly is to keep the bubbles of acetylene gas passing through the water so that it becomes saturated. Approximately half a pound of commercial calcium carbide will produce enough acetylene gas to saturate 11 gallons of water. This is sufficient to treat 1 cwt. of potatoes at a time, but to do this the container would need to have a capacity of not less than 16 gallons.

The uncut potatoes are left in the acetylene solution for 4-5 hours. The potatoes must be whole at treatment, since if they are cut just before or just after treatment, losses due to soft rots may be excessive.

If the tubers do not need cutting into setts they can be planted immediately after treatment, provided the soil is warm and moist. Alternatively, if planting conditions are unsuitable, or the tubers need to be cut into setts, keep the tubers moist between bags or layers of damp straw in a warm place for about a week and then plant as seed tubers or cut into setts as the case may be. If the tubers are cut they should be kept in a warm moist place for 48 hours after cutting and before planting in order to obtain best results.

Some precautions are necessary. Calcium carbide must be kept dry in a tightly closed container, otherwise it deteriorates rapidly. The acetylene gas is inflammable and so naked lights should not be allowed near the place of treatment.

Varieties apparently differ in their sensitivity to dormancy breaking. Those which are fairly responsive to treatment include Factor, Sebago, Katahdin, Bismark, Carman and Delaware.

If it is necessary to treat seed potatoes for Rhizoctonia scab it is advisable to use the acid corrosive sublimate before the acetylene treatment. The treatment has the added advantage of killing potato moth grubs which may be present.

PLANTING.

Although machines are available for planting potatoes, a common practice is to plough the seed in, the field being reploughed for that purpose and the seed planted in every third or fourth furrow according to the width of the plough out. This practice has much to recommend it, as the soil and the seed in the planting furrow are not allowed to remain uncovered for any length of time, the planting and covering of the seed being practically simultaneous operations.

A practical method now often used is to drop the potatoes down a chute arranged on the frame of a three-furrow mouldboard plough, so that the potatoes fall into the middle furrow. A seat is fitted to the plough frame and the boxes containing the setts are placed on one or both sides of the chute. The method can be modified to drop fertilizer directly into the furrow, if so desired.

The seed potatoes are spaced at an even depth and distance apart, the usual distance between them in a furrow being 12-15 inches with a planting depth of five inches. The usual distance between rows is 30-36 inches. As soon as possible after planting, the potatoes should be covered to the correct depth with soil to prevent loss of soil moisture from around the seed. With modern planting machinery, planting and covering are carried out in the one operation.

In the Lower Burdekin area, planting is rarely done during the ploughing but instead the land is prepared and drilled out to the required row spacing. After planting, a small ridge is thrown over the line of the seed potatoes, it being claimed that the ridge gives some protection to the tubers by assuring ample drainage should heavy rain occur. Wide row spacings up to 42 inches are used, the purpose being to allow ample room between the rows for hilling-up operations. The normal sett spacing in this area is 10-12 inches.

CULTIVATION.

The first cultivation should be carried out as soon as the plants appear above the ground. A light tine harrow, preferably a lever type with the tines set slightly back, is the most suitable implement for the purpose. Such cultivation will not only break up the surface soil which may have become slightly caked as a result of rain or irrigation following planting, but it will also destroy any weed growth which may have sprung up between the plants. This is the best opportunity for eradicating such weed growth, as all subsequent cultivations can be carried out only between the rows. The number of inter-row cultivations will depend on seasonal conditions, and, in the case of irrigated fields, on the number of irrigations and the method used, whether spray or furrow. Cultivations should be sufficient, however, to keep weed growth in check and at the same time keep the surface soil in a friable condition. Care should be taken to adjust the scuffler so that the tines do not damage the roots of the plants.

As the plants approach the flowering stage they should be hilled; an effective and popular way of doing this is by fitting hilling attachments to an ordinary scuffler (Plate 209). It should be the practice with each successive hilling operation to gradually hill up the soil about the plants to an apex formation. The main advantages to be derived from hilling are that it prevents tubers, which might otherwise have been exposed, from being discoloured, and it also affords some measure of protection against the potato tuber moth.

Modern light tractors can be fitted with various sets of implements for cultivating and hilling potatoes speedily and efficiently.

During growth a regular spraying schedule should be carried out to control insect pests, and when there is a likelihood of Irish blight occurring in cool showery weather, appropriate preventive measures should be taken.

Plate 209.
Hilling Potatoes with a Scuffler.

Plate 210.
A Useful Potato Spraying Machine.

IRRIGATION.

Potatoes require ample moisture for satisfactory growth and in most potato growing districts respond well to irrigation. Irrigated crops produce higher yields and give tubers more uniform in size and quality. The water should be applied in sufficient quantities to keep the crop growing evenly without stress periods. The water requirements are greatest during the period of tuber development, which is from the flowering stage until near maturity. During this period the soil should be kept moist, for if it is allowed to dry out and then watered, the tubers are likely to sprout and develop second growth.

The amount of water to apply at each watering and the number of waterings will vary with soil type and seasonal conditions. Light textured soils require light waterings at fairly frequent intervals during dry periods; heavier soils can absorb more water and may be irrigated more heavily at less frequent intervals. The amount of water applied should always be sufficient to wet the soil within the root zone of the

Plate 211.

Spray Irrigation of Potatoes.

plant. One to two inches per application is usually sufficient for light soils while two to three inches may be required for soils in the clay loam class.

Heavy soils, where bad drainage and ponding of water are likely to be serious risks, should be avoided. Rain immediately after irrigation in such cases is likely to cause waterlogging of the soil and heavy losses of potatoes due to disease. It is recommended that soils of this type be not used for growing irrigated potato crops.

Either spray or furrow irrigation may be used, the choice of method being influenced mainly by local circumstances. Spray irrigation (Plate 211) makes more economical use of water but entails considerable initial expense in the provision of equipment. Where ample supplies of water are available the furrow method is easier to operate. However, on fields of uneven surface topography grading is necessary before furrow irrigation can be applied to the best advantage. This problem may be of sufficient importance on some farms to warrant the adoption of spray irrigation in preference to the furrow technique. Occasionally, a combination of both methods is found to fit in satisfactorily with farm routine and the grower's labour supply. In this case, the common practice is to use spray irrigation for the establishment and early growth of the crop and carry out furrow irrigation in the later stages.

In the Lockyer and Fassifern Valleys, spray irrigation is favoured, but in the Lower Burdekin, where large supplies of irrigation water are available, the furrow technique is mainly adopted.

HARVESTING.

Harvesting, in the case of the spring crop, is usually carried out as soon as it can be undertaken safely. The hot, stormy weather which normally prevails when the spring crop is due for harvesting, and the risk of damage by the potato tuber moth, which is then particularly prevalent, make it necessary to harvest the crop as expeditiously as possible. It is not advisable, however, to dig the potatoes before the skins are firm, as immature potatoes are likely to arrive on the market in a badly rubbed and damaged condition. As the autumn crop ripens during the cooler months of the year the tubers may be left much longer in the ground after the crop has ripened than is the case with the spring crop, and, if desired, digging need not be carried out until the tops have completely dried out.

Harvesting is carried out either with a plough or with a mechanical digger. Single furrow ploughs are frequently used. These raise the potatoes and spread them on the surface, but some are always left buried in the ground. Mechanical diggers are more efficient and are rapidly replacing the plough. Both the spinner and the elevator types are used. These do good work on clean crops and on loose friable soils, but do not perform so satisfactorily on heavy soils. Farmers on the alluvial soils of the Lockyer Valley favour the elevator type diggers over the spinner type. Most mechanical diggers leave the potatoes on the surface of the ground, but recent adaptations designed to pick up and bag the potatoes aim at complete mechanization of potato harvesting.

The tubers, after being dug, should not be left exposed to the hot sun for any length of time, and they should be bagged and removed from the field as quickly as possible. Furthermore, the bagged tubers should on no account be covered with the tops while standing in the field, as this is one of the surest ways of introducing the tuber-moth pest to the bagged tubers. The harvested tubers can be protected from infestation by this pest by treatment with insecticidal dusts.

The average yield per acre in Queensland is approximately 2½ tons of first grade tubers, which is the lowest figure for any Australian State. However, yields of 6 tons of first grade tubers per acre are commonly reported, and under ideal conditions yields of 10-12 tons have been obtained in south-eastern Queensland. More attention to the selection of soil, more care in the maintenance of its physical structure and fertility, the use of certified seed and more extensive application of pest and disease control measures are considered to be essential for raising the average acre yield in Queensland.

GRADING AND MARKETING.

When preparing tubers for market they should be carefully graded to conform with regulation standards as regards maturity, size and freedom from blemishes. Care should be taken to reject any tubers which are damaged or show signs of potato tuber moth infestation, and on no account should bruised tubers or tubers with dirt adhering to them be included when bagging. The tubers should be packed firmly in the bags, but not too tightly, as such tight packing is likely to cause bruising, which will be followed by decay. Too loose packing is equally objectionable for the same reason.

Grading of potatoes is now compulsory and no person may sell or offer for sale in Queensland any potatoes which do not comply with the grade standards prescribed under the regulations of "The Fruit and Vegetables Act." Copies of the grade standards may be obtained on application to the Department of Agriculture and Stock.

The following clause in the constitution of the Potato Marketing Board in relation to the treatment of potatoes before forwarding to the Board, is quoted for the guidance of growers:—

"The Board may at any time and from time to time, by notice given by the Board in such manner as the Board may see fit, require that during such period as shall be fixed by the Board every grower delivering any of the commodity to the Board or its authorised agents shall before delivery thereof properly dust the whole of the commodity so intended to be delivered with any 'Pest Destroyer' within the meaning of '*The Pest Destroyers Act of* 1939' (or any Act or Acts in amendment or modification thereof or substitution therefor) specified by the Board."

PESTS AND DISEASES.

Losses due to pests and diseases can be a severe handicap to the potato grower and careful attention to all practical control measures is required if high yields of first grade potatoes are to be obtained.

Common diseases include various wilts, Irish blight, target spot, viruses and scab. The use of certified, disease-free seed potatoes, crop rotation and seed treatment are essential control measures. In selecting varieties for planting the use of disease resistant types should be kept in mind. Breeding programmes in southern States from which Queensland secures its seed are paying particular attention to the development of disease resistant varieties. Some are already available, and as more are released for general planting, growers should make use of those which are adaptable to local conditions.

The main pest is the potato tuber moth, but recent advances in the use of new insecticides have done much towards the solution of this problem.

Full details on the habits and control of these and other potato pests and diseases may be obtained on application to the Science Branch of the Department of Agriculture and Stock.

Brucellosis Testing of Swine.

The Department of Agriculture and Stock is operating a scheme whereby pig herds are tested at intervals for the occurrence of swine brucellosis (contagious abortion).

A herd listed by the Department as ''brucellosis tested'' is one in which all such animals as may be determined by the Director of the Department's Division of Animal Industry have been subjected to two successive tests for brucellosis, at intervals determined by him, without any positive reactors being found.

In order for a herd to be retained on the list of Tested Herds, a semi-annual or annual re-test of the herd, as determined by the Director, is required. If at a re-test any animal gives a positive reaction to the test the herd is removed from the list; it is not listed again until subsequest tests, as determined by the Director, have been carried out.

Full particulars of the Brucellosis Testing of Swine and application forms may be obtained from the Under Secretary, Department of Agriculture and Stock, William Street, Brisbane.

TESTED HERDS.

(AS AT 15th MAY, 1951.)

Breed.	Owner's Name and Address of Stud.
Berkshire	S. S. Ashton, " Scotia " Stud, Pittsworth
	J. J. Bailey, " Lucydale " Stud, East Greenmount
	S. Cochrane, " Stanroy " Stud, Felton
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	G. Handley, " Handleigh " Stud, Murphy's Creek
	J. L. Handley, " Meadow Vale " Stud, Lockyer
	R. G. Koplick, " Melan Terez " Stud, Rochedale
	H. V. Littleton, " Wongalea " Stud, Crow's Nest
	O'Brien and Hickey, " Kildurham " Stud, Jandowae East
	E. Pukallus, " Plainby " Stud, Crow's Nest
	G. C. Traves, " Wynwood " Stud, Oakey
	E. Tumbridge, " Bidwell " Stud, Oakey
	Westbrook Farm Home for Boys, Westbrook
	H. W. Wyatte, Rocky Creek, Yarraman
	H. M. State Farm, " Palen Creek," Palen Creek
	A. R. Ludwig and Sons, " Cryna " Stud, Beaudesert
	H. H. Sellars, " Tabooba " Stud, Beaudesert
Large White	H. J. Franke and Sons, " Delvue " Stud, Cawdor
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	F. L. Hayward, " Curyo," Jandowae
	J. A. Heading, " Highfields," Murgon
	K. B. Jones, " Cefn " Stud, Pilton
	R. G. Koplick, " Melan Terez " Stud, Rochedale
	R. Postle, " Yaralla " Stud, Pittsworth
	E. C. Smith, " Smithfield " Stud, Coomera
	E. J. Bell, " Dorne " Stud, Chinchilla
	A. G. Fry, " Birubi " Stud, Dalby
	M. E. Meyers, Halpine Plantation, Kallangur
	L. C. Lobegeiger, " Bremer Valley " Stud, Moorang, *via* Rosewood
Tamworth	S. Kanowski, " Miecho " Stud, Pinelands
	N. R. Potter, " Actonvale " Stud, Wellcamp
	D. F. L. Skerman, " Waverley " Stud, Kaimkillenbun
	A. C. Fletcher, " Myola " Stud, Jimbour
	L. C. Lobegeiger, " Bremer Valley " Stud, Moorang, *via* Rosewood
Wessex Saddleback ..	W. S. Douglas, " Greylight " Stud, Goombungee
	D. Kay and P. Hunting, " Kazan " Stud, Goodna
	E. Sirett, " Iona Vale " Stud, Kuraby
	C. R. Smith, " Belton Park " Stud, Nara
	H. H. Sellars, " Tabooba " Stud, Beaudesert
	H. Thomas, " Eurara " Stud, Beaudesert

The Harvesting, Handling, Packing and Marketing of Bananas.

C. G. WILLIAMS, Supervisor (Preparation and Transport), Horticulture Branch.

IN sub-tropical Queensland, the principal commercial varieties of bananas are mostly grown on rugged hillside situations, which makes harvesting and transport conditions difficult. Consequently, the fruit is often unavoidably damaged during transport to the packing shed. Fortunately, the banana has a very efficient protective skin which will withstand a considerable amount of rough treatment. The results of very rough treatment of the fruit become apparent as dark, bruised patches on the skin when the banana ripens. The appearance of such fruit depreciates its sales value. Where it is possible to install an overhead wire transportation system from the plantation to the packing shed for the conveyance of bunch or cased fruit, transport difficulties and associated fruit damage will be considerably reduced.

Bananas are adversely affected by large variations in temperature. It is therefore essential that harvesting should be performed during the cool morning period of the day.

Harvested bunches should be stood vertically in a shaded section of the plantation or loading depot, and if necessary, they should be covered with leaf trash or other additional protection against the direct rays of the sun.

In the packing shed the bunches should be placed in a cool, shaded and well ventilated position. It is important that the fruit be prepared for market and transported with a minimum of delay. The cased or bunched fruit in transit to the market must not be subjected to exposed conditions under the hot sun.

On all occasions, transport and associated arrangements should provide efficient protective conditions against overheating or chilling of the fruit.

It is essential that fruit receive careful handling and that the packing shed and equipment be designed for comfortable, expeditious and hygienic handling, grading, and packing of the fruit. The procedures recommended in this respect are given in this article.

HARVESTING.

Maturity.

The bunches should be cut from the plants with a heavy knife (such as a cane knife) when the fruit is at a green mature stage. In determining this stage of maturity the grower will be guided by local and seasonal conditions applicable to the development of his fruit.

It is recognized that the ideal green mature banana of the Cavendish type is one that is full of substance, almost round in lateral shape and light green in colour. Bananas maturing during late winter and spring may be somewhat angular in lateral appearance, yet, if such fruit is allowed to remain on the plant until it becomes more round or full in substance, the skin may crack and the fruit will ripen and thus become unsuitable or too soft for distant transport. This, in effect, means that the grower must use his own discretion as to when the bananas are at a green mature stage sufficient to ensure good quality on ripening.

With Lady Finger and plantain types, the green mature fruit is angular but full laterally, not flat.

The Sugar type must be full round in lateral shape when mature.

Cutting the Bunch from the Plant.

If the extended main stem (flower bract) of the bunch has not been cut off, it should be removed by cutting it to about two inches below the bottom hand on the bunch. This protruding two-inch length of main stem will take the weight and shocks in subsequent handling when the bunch is stood in a vertical position, as it always should be. A yoke will be found very useful for transporting the bunches from the plants to the loading centre. The bunches should not be stacked in a horizontal position as this may result in bruised and broken fruit. Clean banana leaf trash is an excellent padding material for bunch protection.

THE PACKING SHED.

The packing shed is usually placed either within the plantation, if the topography of and the road access to the site will permit, or as near as possible thereto. If an overhead wiring system is used the packing shed may be located at a convenient central receiving site or at a wiring station terminal accessible from the main road outlet. At the latter location, a central packing shed would be the receiving centre for bunches conveyed by overhead wires from one or several points in the plantation. An illustrated leaflet relative to a wiring system for banana plantations is available on application to the Department.

The prime productive period for any one area of bananas is relatively short. Therefore, it is not economical, except in a central position served by numerous progressive areas, to construct a packing shed of an elaborate permanent type on any one location. However, the shed should be designed to have:—

(1) Ample ventilation and windows to give good internal lighting.

(2) Sufficient space for storage of bunches and for dehanding the bananas.

(3) Divided benches or floor space for graded fruit.

(4) Space for a lid clamp and nailing down stand.
(5) Space for made-up cases and case timber.
(6) Sufficient room for stacking the cased fruit close to the outlet door.
(7) Accessibility from an all-weather road outlet.

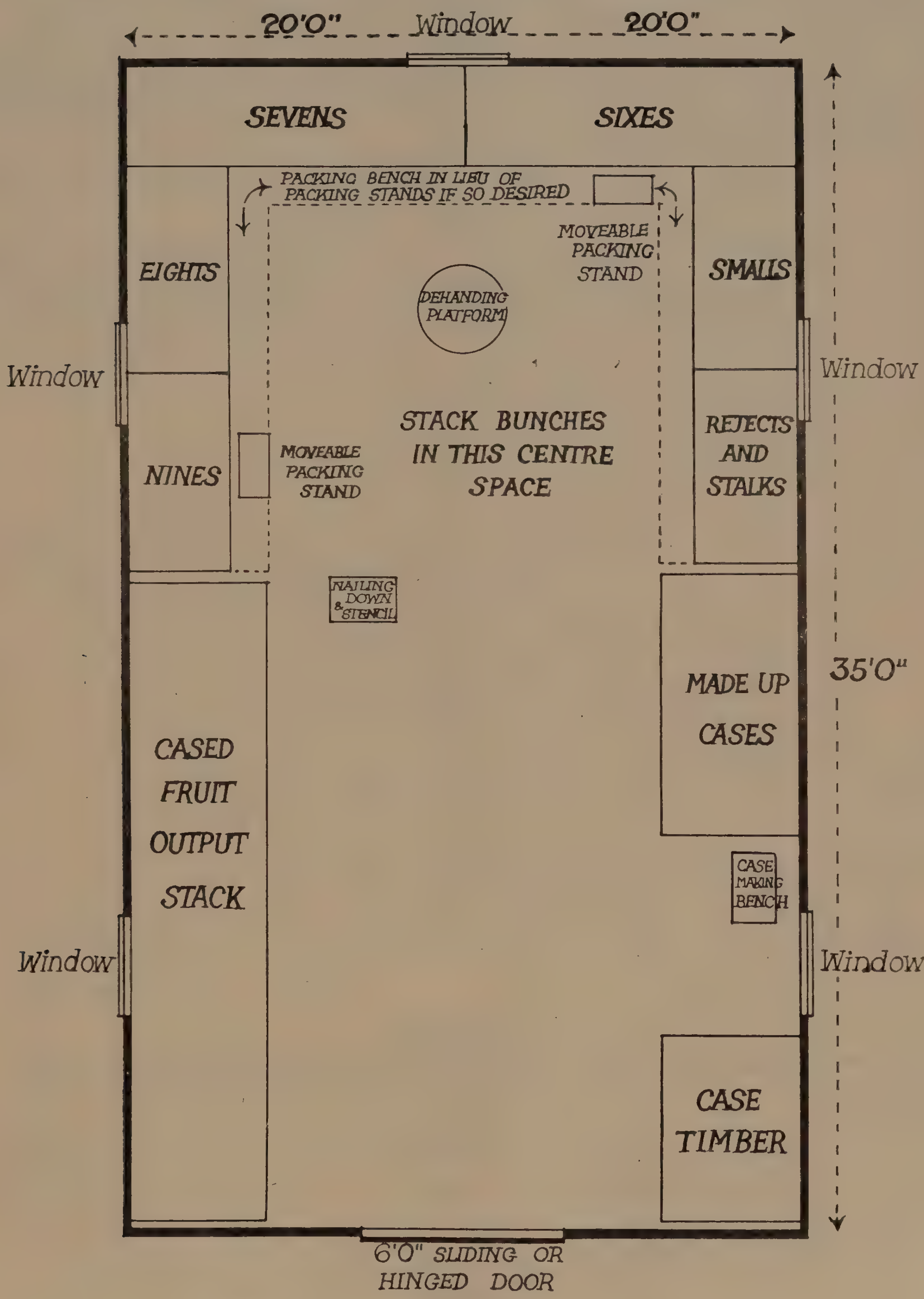


Plate 212.

Floor Plan of Banana Packing Shed.—The bins containing the fruit should be constructed to stand 3 ft. 6 in. at the back and 3 ft. 3in. at the front from floor level. The dehanding stand should be a raised, circular, moveable platform of sufficient size for bunch dehanding and the breaking of the hands into grade size groups. The grade groups from each bunch should be transferred to the respective grade bins.

A floor plan of a banana packing shed is shown in Plate 212. Although this shed may be too large for the average grower, it can, if necessary, be reduced in size as required. The shed need not be elaborate in its structure, but for hygienic reasons it is advisable to have a raised wooden floor. Ample ventilation and good internal lighting are essential.

PACKING SHED EQUIPMENT.

The equipment required in the packing shed consists of a few essential items. These articles of equipment should make packing more efficient and expeditious. They are:—

(1) Case making bench (Plate 213);

(2) Nail clincher and template (Plate 214);

(3) Stencils: (*a*) grower's name and address; and (*b*) grade sizes, namely "SMALL," "SIXES," "SEVENS," "EIGHTS," "NINES," "STANDARD," "LARGE";

(4) Stencilling brush and ink or ink block container;

(5) Dehanding knife (Plate 215);

(6) Nailing down clamp (Plates 216-220).

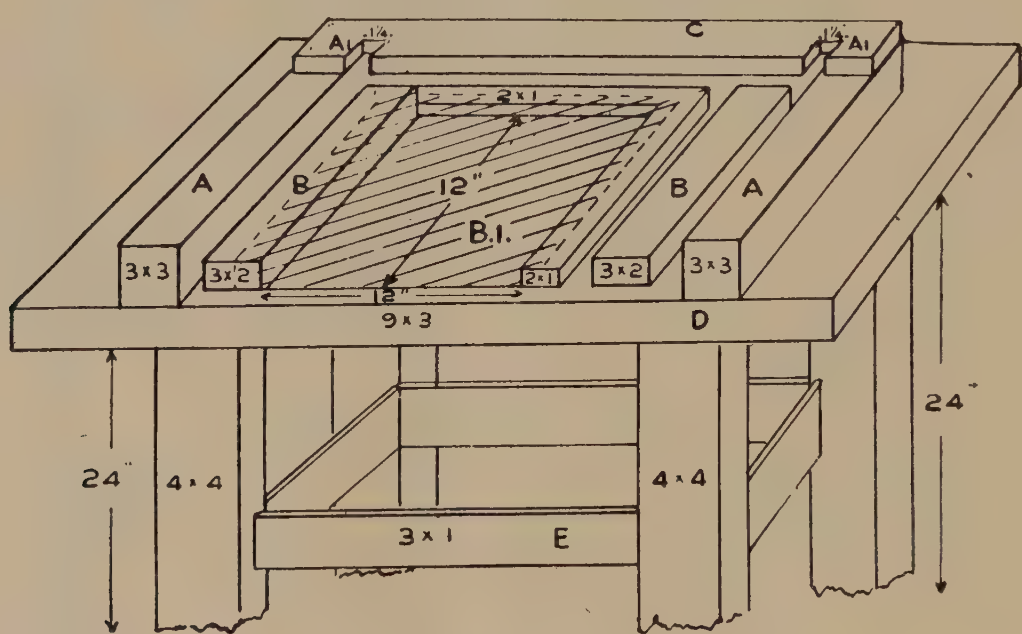


Plate 213.

Banana Case-making Bench, Showing Method of Attaching Case End, Template and Nail Clincher.

SPECIFICATIONS:

Length—42-50 inches;

Height—24 inches to underside of top;

Width—24 inches;

Template (B.1.)—As shown in Plate 214;

Timber—Legs, 4 x 4; Stops, (A) 3 x 3 x 13½; (B) 3 x 2 x 12, (C) 3 x 1 x 34; Top (D), 3 pieces 8 x 3 of desired length; Stays, 3 x 1.

DESCRIPTION:

The Stops A and B are placed approximately 1½ inches apart, with C placed across the back ends of A and B. A cut 1 inch deep and 1½ inches wide is made in the back stop to correspond with the slot between A and B. The back end of this cut should be 12 inches from the front of the bench. B is placed ½ inch from the front edge.

Template and Nail Clincher.

Many growers find difficulty in making up two-piece ends for fruit cases into correct widths; this is due often to the badly-cut timber. This can be easily overcome by attaching a template, in the form of a three-sided wooden frame, to the shed bench (Plates 213-214). A piece of flat sheet iron is placed to cover the space enclosed by the sides of the template. This acts as a nail clincher, turning the ends of the nails when the cleats used for joining the two pieces making the end are hammered on.

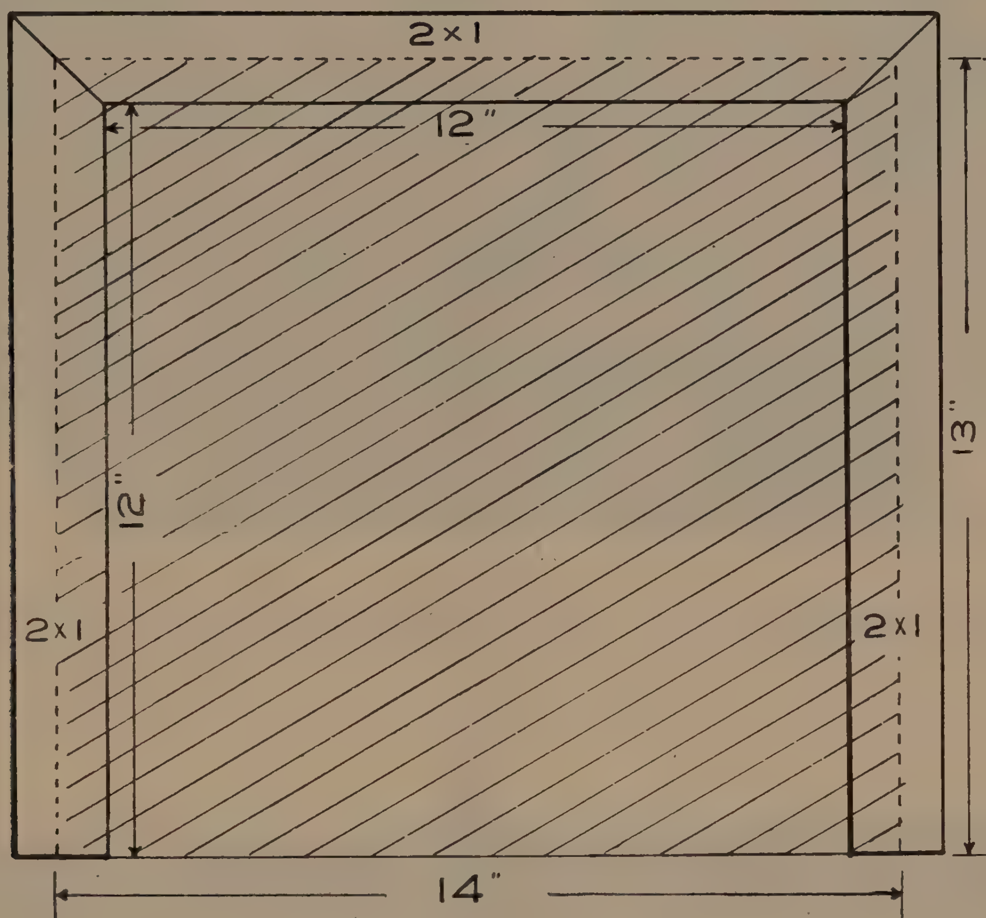


Plate 214.

Plan of Nail Clincher and Template.—This can be made separately or fitted to the case-making bench. The dotted line enclosing the shaded portion shows the shape of the piece of sheet iron, which is valuable for joining two-piece ends. The materials required are 2 pieces of 2 x 2 14 inches long, 1 piece of 2 x 1 16 inches long, 1 piece of sheet iron 14 x 13 x $\frac{1}{8}$ inch, and necessary nails.

Dehanding Knife.

A good dehanding knife is an essential tool. Much time will be saved with this tool. A long tapered sharp blade is ideal, permitting the operator to make the semi-circular cut with ease. Wide-ended blades of the carving knife pattern are slow and unsatisfactory.

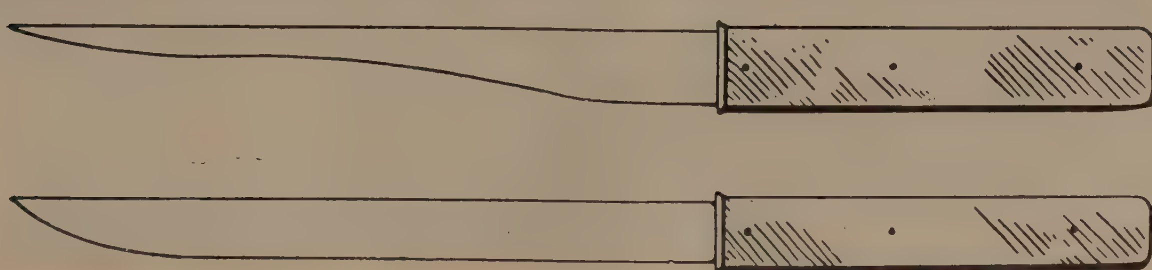


Plate 215.

Suitable Dehanding Knife (top).—The thin blade makes the necessary semi-circular cut easy. The other knife is unsuitable.

Nailing Down Clamps.

On account of the height of the finished pack above the top of the case, it is necessary that an efficient type of lid clamp be used. Plates 216-220 show two types of clamps and their mode of operation.

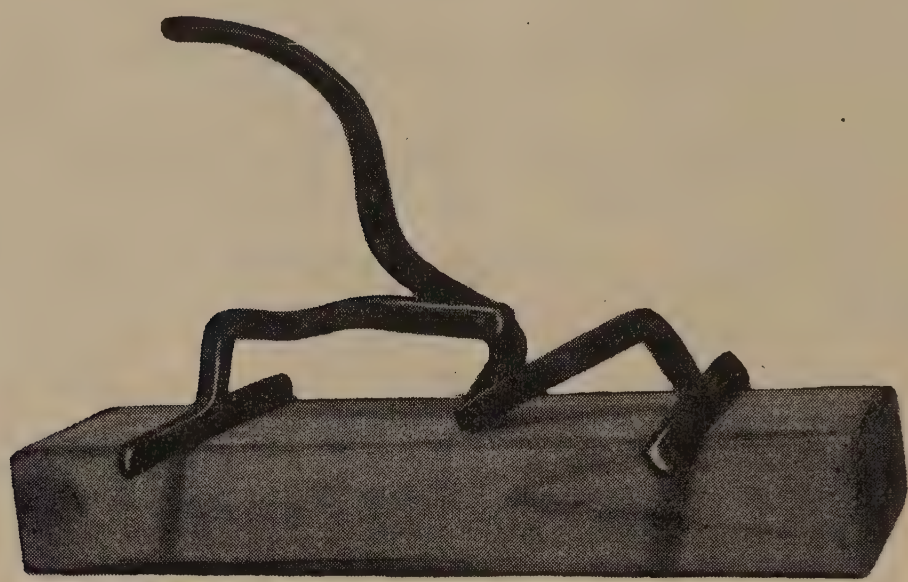


Plate 216.

An Iron Nailing Down Clamp which can be Made Cheaply by a Blacksmith.

Plate 217.

The Clamp in Position Before Applying Pressure.

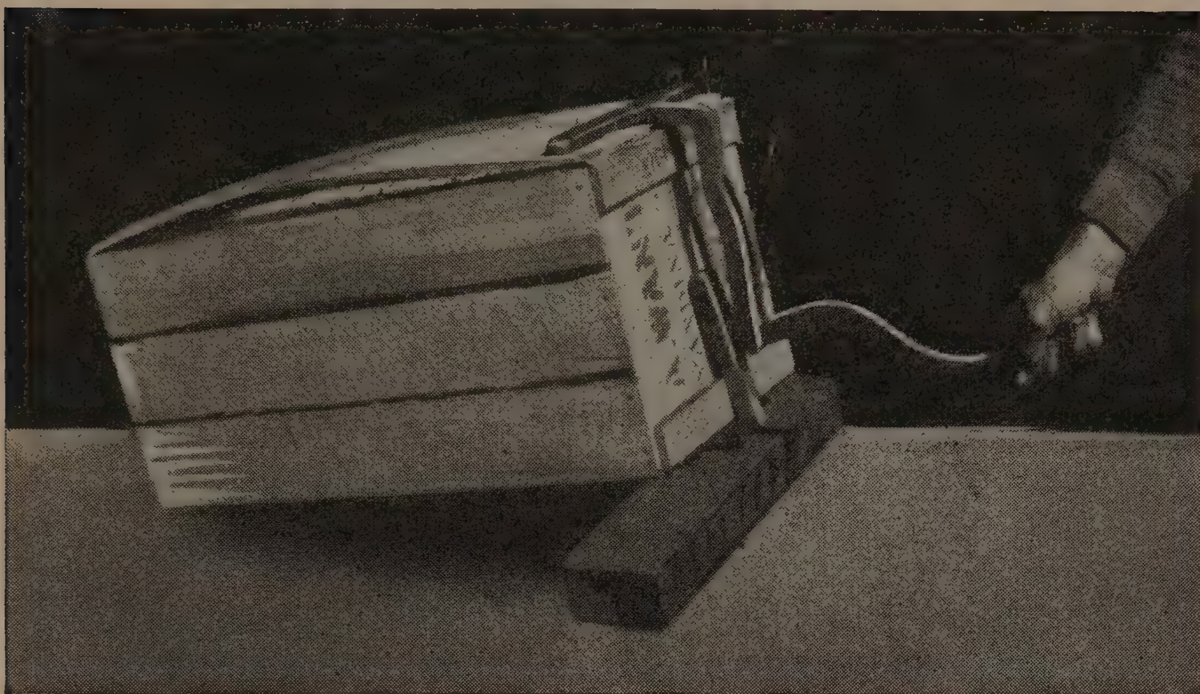


Plate 218.

Pressure Applied to Bring the Lid into Position Ready for Nailing.

Plate 219

Another Type of Iron Clamp Ready for Pressure to be Applied.

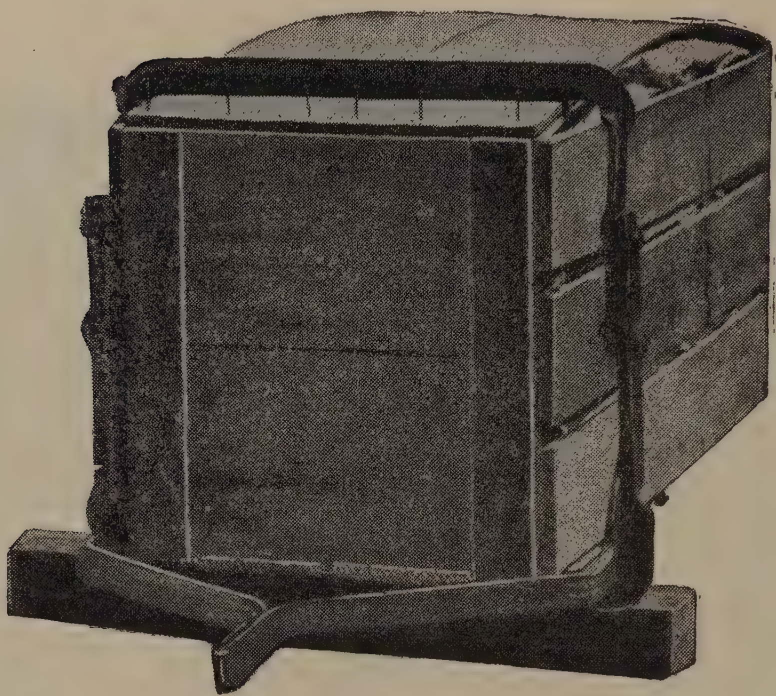


Plate 220.
Pressure Applied and the Lid Ready for Nailing.

MARKETING IN THE BUNCH.

In some instances, growers near market centres forward their fruit in the bunch. The Lady Finger variety is usually despatched in this manner. Bananas marketed in the bunch should be trimmed in the plantation packing shed, all undeveloped, broken, bruised, deformed and ripe bananas being cut out with a sharp thin-bladed knife.

As previously mentioned, all bunched fruit should be stood in a vertical position. Banana leaf trash or any other suitable material should be used as padding under and between the bunches. When this practice is not adopted the fruit is invariably skin damaged, and the percentage of waste from bruised and broken fruit is high. When bananas are marketed in the bunch, the weight of fruit in each bunch should be legibly impressed or branded on the top end of the stalk. The bunch should be weighed after all undersized or unsound fruit has been removed from the bunch and the bunch stalk has been cut so that it does not extend more than six inches from the junction of the stalk and the first hand of bananas.

MARKETING IN THE CASE.

Bananas for distant markets are despatched from the plantation in cases. The trade prefers the fruit in packs known as singles. This, as the pack implies, means that each fruit has to be detached from the hands of the bunch.

Dehanding.

To remove the fruit from the bunch, a cut is made through the flange or joining-piece along the raised brown ridge (4 in Plate 221). Occasionally a slight variation in the placing of this cut may have to be made owing to some hands differing slightly in the way they are attached to the stalk. Notwithstanding any slight difference as mentioned, the cut should always be made at least a quarter of an inch from the girdle (3) around the shank of the fruit, leaving a small piece of the wood attached to the shank (Plate 222). It may be necessary with awkwardly shaped bunches to avoid damage to adjoining hands by making two cuts, one to remove the hand, and a second to trim away

any surplus wood before breaking for packing. Hands removed from the bunch in this manner will easily break into part hands or singles, leaving a small length of the corky wood attached at the end of the shank to dry out. This assists in protecting the fruit from black-end, squirter, and other infections, also leaving the shank full and well-shapen after ripening.

Plate 221.

A Full Hand of Bananas Cut Through the Stalk of the Bunch.—1, the fruit; 2, the shank or neck of the banana; 3, the raised girdle around the neck of the banana where the fruit is joined to the flange; 4, the raised brown ridge running round the flange or piece joining the fruit to the stalk; 5, the joining-piece or flange; 6, cross section of the bunch stalk.

Plate 222.

Hand Removed from the Bunch.—Note the absence of excessive wood. If in doubt it is better to leave too much wood, as a second cut can always be made if necessary to complete the operation.

Cutting the hand from the stalk and leaving too much wood on the hand makes it difficult to break the fruit from the hand. This may cause the shanks or stalks to become wrenched, and, in some cases, torn.

Breaking the Hands.

Breaking the hands into clusters or singles will present no difficulties if the dehanding has been carried out correctly. The easiest method of breaking is to support the full hand of bananas along the arm with the operator's hand spread beneath one end and the other end resting on the wrist and forearm. The fruit is then broken from the hand by being gripped firmly by the shank (Plate 223) and broken off by the use of a semi-circular motion. On no account should fruit be pulled or wrenched from the hand.

Plate 223.

Method of Holding the Hand of Bananas for Breaking.—The weight of the fruit is supported by the arm, preventing any possibility of strain on the shanks of the fruit. Note how the fruit is held by the shank.

Handling by the shank only, so far as the shape of the hand will allow, is of the utmost importance. Some operators hold the hands by the flower end of the bananas when breaking. This must cause damage to the fruit and increase the possibility of transit and ripening troubles. Cutting the hands into singles or part hands is to be recommended, but it is doubtful whether most growers would consider it economical to do this when banana prices are low. When prices are at payable levels, cutting the fruit from the hand is always payable. Cutting gives an excellent appearance to the fruit after ripening. Example of well-broken and cut bananas are shown in Plate 224.

Care in handling and cleanliness in the packing shed are necessary in order to eliminate chances of fungal infections which lead to squirter and black-end.

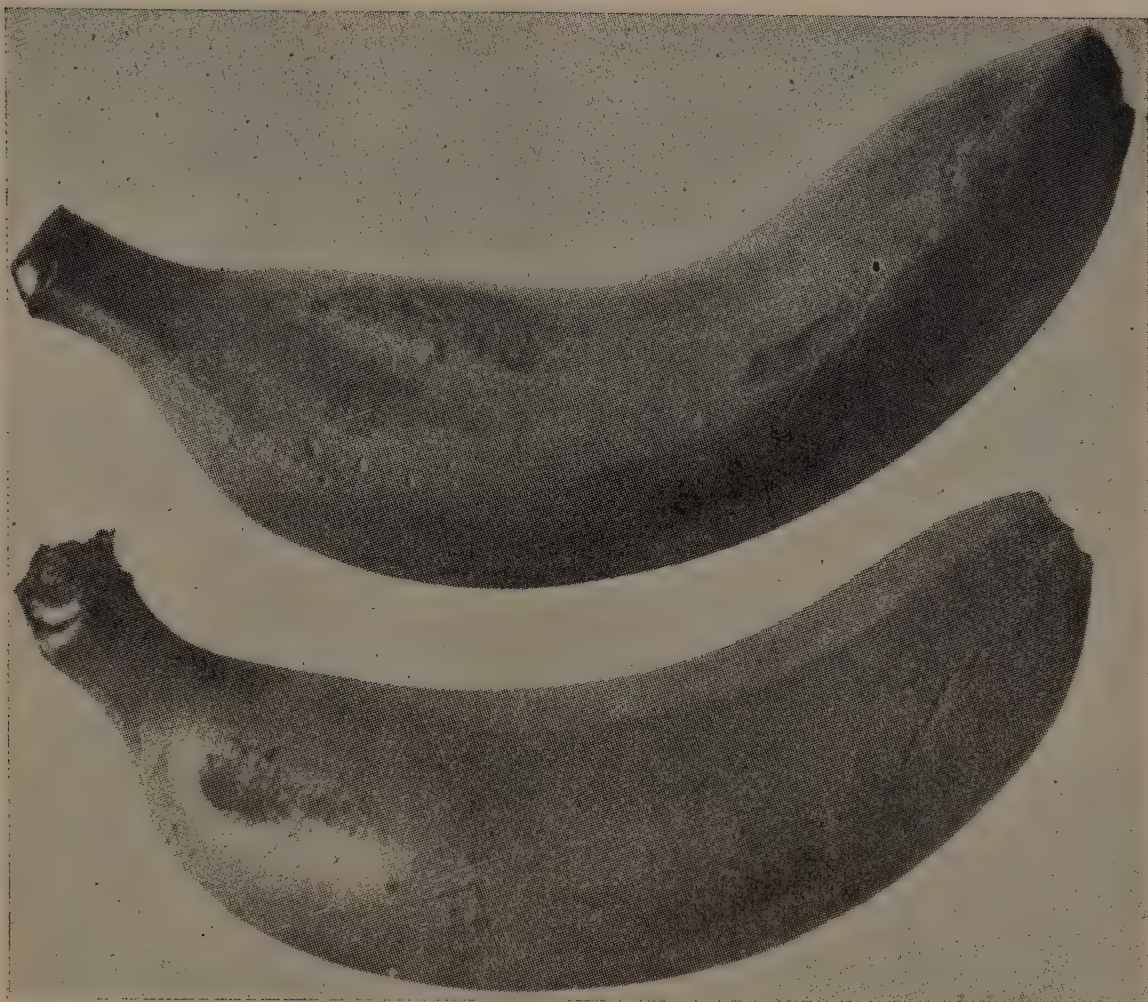


Plate 224.

Good Single Fruit.—Top, a fruit cut from the hand; bottom, a fruit broken from the hand, leaving some wood adhering to the end of the shank.

GRADING.

After the hands have been cut the bananas should be graded for size into either "Small," "Sixes," "Sevens," "Eights," or "Nines." Grade specifications are as follow:—

"*Small*" shall consist of bananas not less than five inches but less than six inches in length and not less than four inches in circumference.

"*Sixes*" shall consist of bananas not less than six inches but less than six-and-a-half inches in length and not less than four inches in circumference.

"*Sevens*" shall consist of bananas not less than six-and-a-half inches but less than seven-and-a-half inches in length and not less than four inches in circumference.

"*Eights*" shall consist of bananas not less than seven-and-a-half inches but less than eight-and-a-half inches in length and not less than four-and-a-quarter inches in circumference.

"*Nines*" shall consist of bananas not less than eight-and-a-half inches in length and not less than four-and-three-quarter inches in circumference.

The method of grading bananas for size is demonstrated in Plate 225.

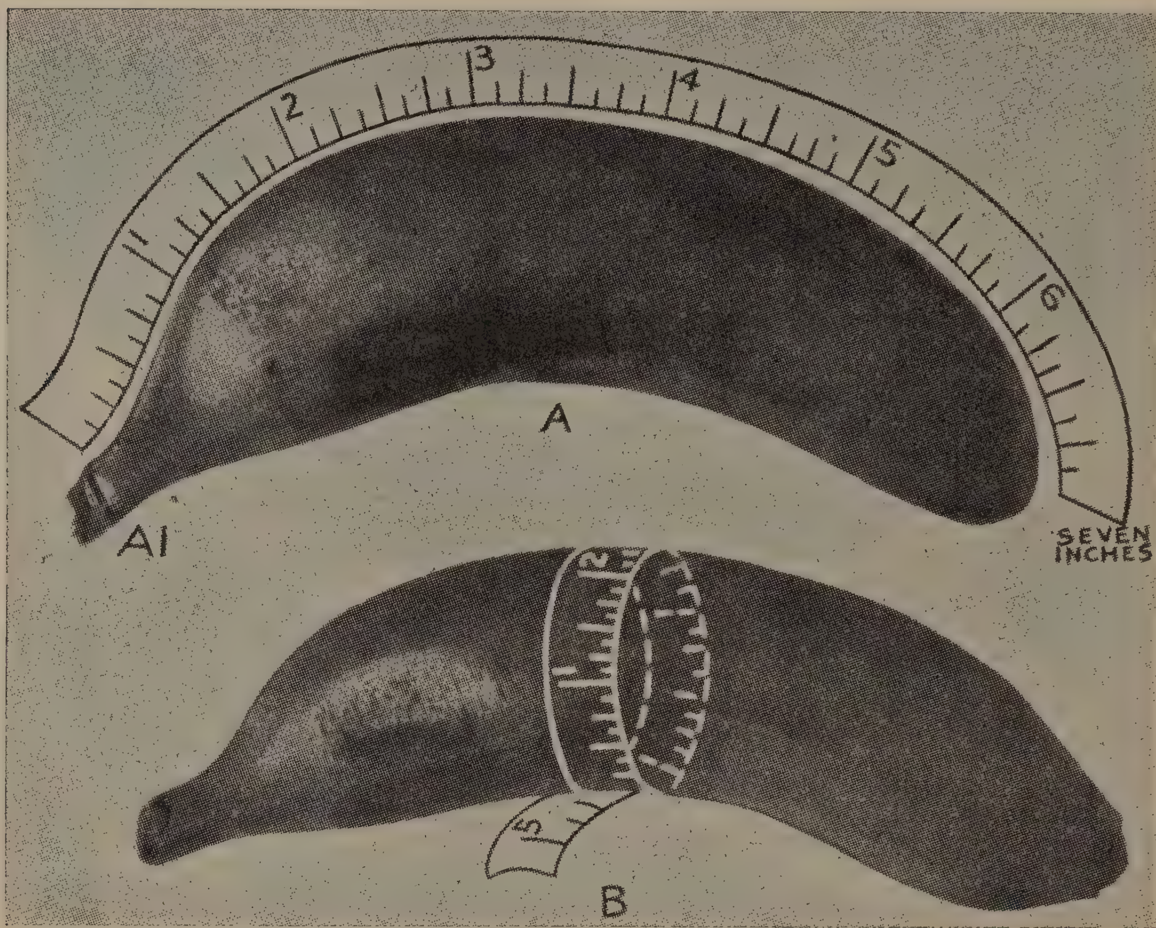


Plate 225.

Measuring the Length and Girth of a Banana.—The length is taken from the raised girdle (A1) to the centre of the end; measurement for girth is made at the middle of the fruit.

PACKING CAVENDISH AND SIMILAR TYPES.

The singles pack is most commonly used in the cased banana trade for Cavendish and varieties of similar type. Other packs, such as clusters or full hands, are not generally favoured by the trade.

Bananas in full hands or clusters, if packed firmly, will carry much better to distant markets than singles, which are more subject to breakdown and mould wastage than hands or clusters. With singles, a greater weight per case is obtained in comparison with the cluster or full hand packs.

The time taken in packing each type of pack is approximately 10-15 minutes per case for singles, 6-10 minutes for clusters, and 2½-5 minutes for full hands.

The Singles Pack.

The case should be fully lined with plain white paper or newspaper.

To commence the singles pack, two rows of evenly sized graded bananas are placed in line on the bottom of the case as shown in Plate 226. It will be noted that the stalk ends of the fruit are placed against the side of the case.

The second and successive layers of bananas are placed as far as possible in the spaces between the fruit in the previous layer concave downwards. The space between the two rows of bananas in the layers should be filled in with the fruit in the manner shown in Plate 227. This vertical arrangement of placing the fill-in bananas in the centre spaces may be varied by arranging the fruit into a flat and firm position progressively with the pack.

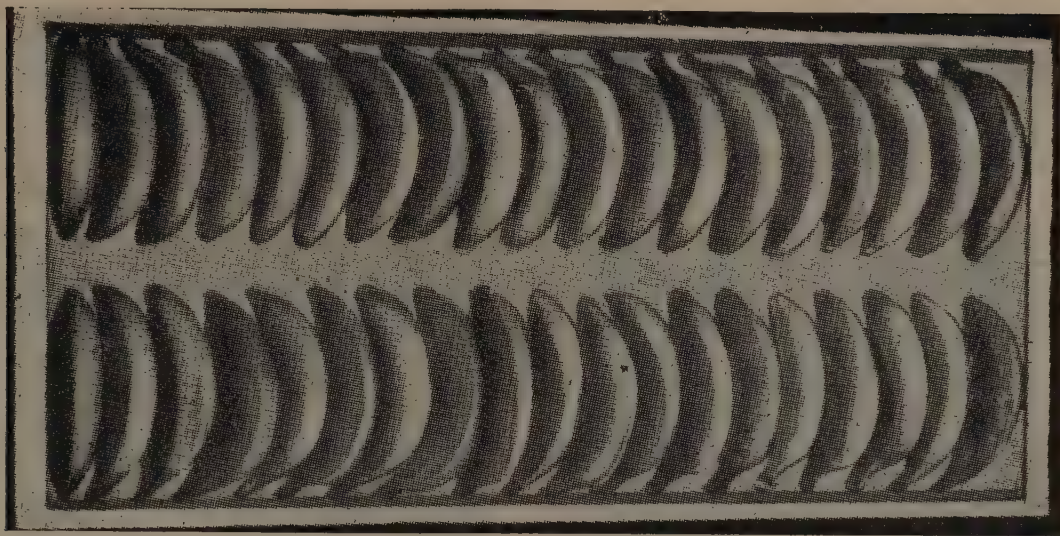


Plate 226.

Singles Pack.—The first layer of "sixes," "sevens" and small "eights" is placed as shown; the centre space varies in width according to the size of the fruit.

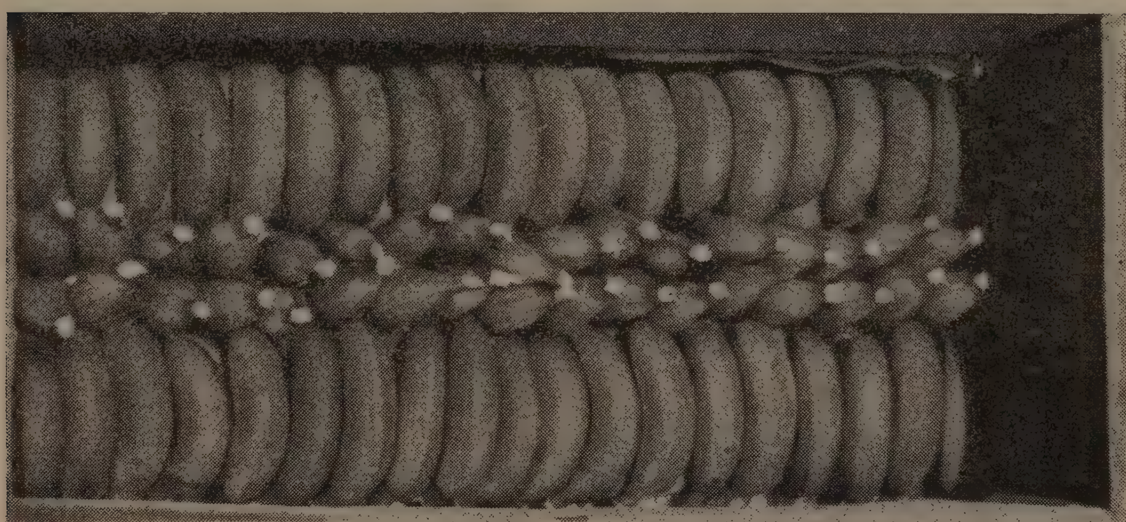


Plate 227.

Singles Pack.—Method of placing the second layer. Note the vertical method of placing the centre fruit when pegging.

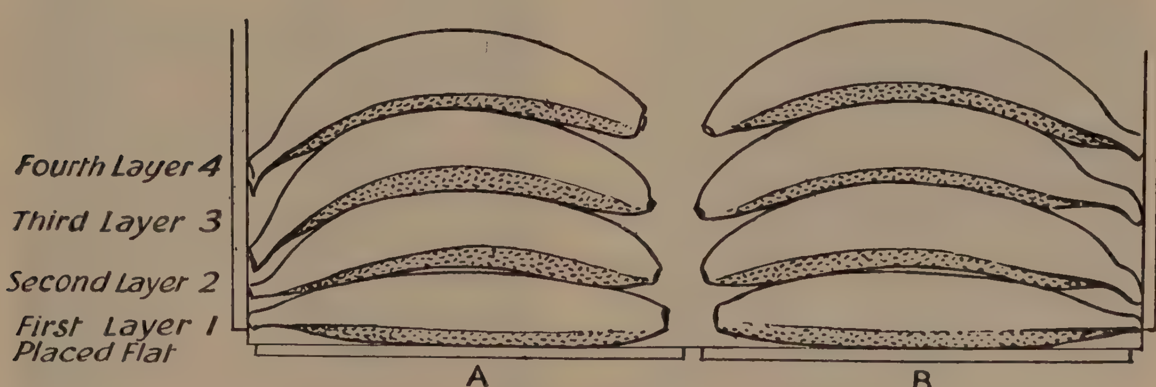


Plate 228.

Singles Pack.—Diagram showing correct and incorrect methods of placing the fruit. A, correct method, with shanks of fruit placed well down the side of the box. B, incorrect method, showing layers of fruit packed without placing the shanks well down the side of the box. Care should be taken not to place the shanks of the fruit too far over, as skin marking will develop on the soft shoulders of the fruit.

When packing the successive layers, the shank end of the bananas should be placed well down the side of the case as shown in Plate 228. In the building up of successive layers the pack should be kept firm. The bananas should be placed into appropriate spaces between the fruit in the layer underneath (Plates 229-231).

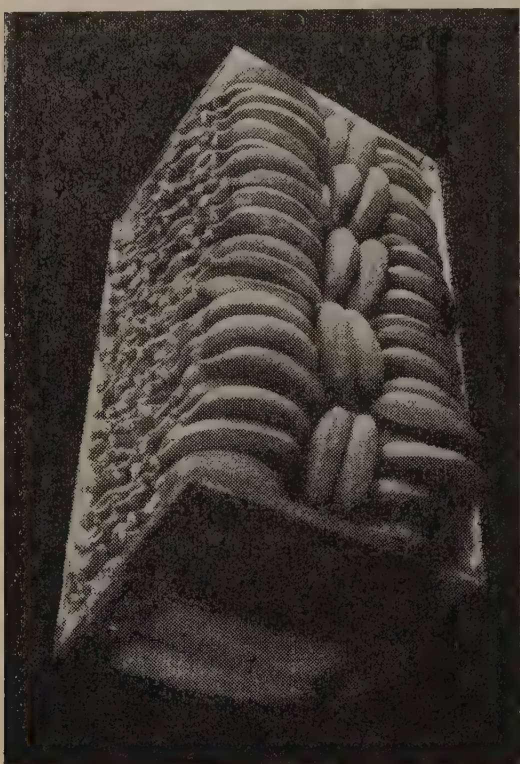


Plate 229.
Singles Pack—"Sixes."

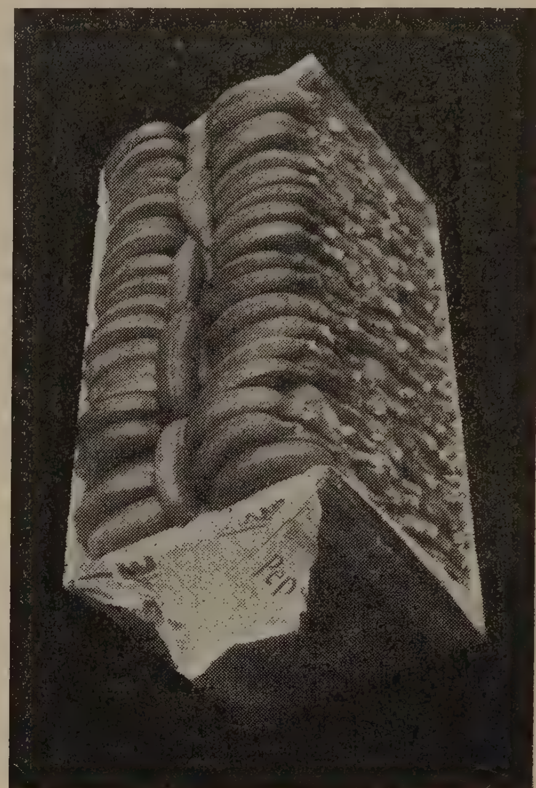


Plate 230.
Singles Pack—"Sevens."

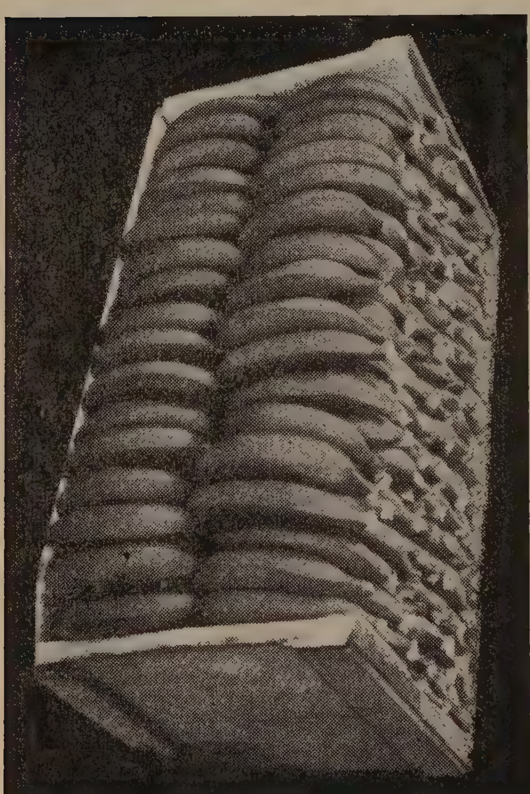


Plate 231.
Singles Pack—"Eights" or "Nines."

Plate 232.
Stacking Cases—The Right Way (left) and the wrong.

If the pack is not done in a systematic manner with evenly graded bananas, it will not be possible to obtain the required weight of fruit per case (approximately 75 to 80 lb.). Further, a badly packed case will arrive at its destination with the fruit in a loose condition and bruised.

The finished pack should be $2\frac{1}{2}$ inches above the top of the case at the centre and about one inch above at each end. This top bulge will be pressed evenly into position when the lid is applied by means of the lidding clamp.

All packed cases should be placed on their sides (see Plate 232). If the cases are stacked on the bulge, the fruit will be bruised, particularly on the top and bottom layers.

Cluster and Full Hand Packs.

Bananas packed in clusters or hands are graded into one or other of three sizes, namely, "Small," "Standard," and "Large," the specifications of which are as follows:—

"*Small*" shall consist of bananas not less than five inches but less than six inches in length and not less than four inches in circumference.

"*Standard*" shall consist of bananas not less than six inches but less than seven-and-one-half inches in length and not less than four inches in circumference.

"*Large*" shall consist of bananas not less than seven-and-one-half inches in length and not less than four-and-one-half inches in circumference.

A case packed with clusters shall contain not less than 90 per cent. by number of bananas combined in clusters.

A case packed with hands shall contain not less than 80 per cent. by number of bananas combined in hands.

The Cluster Pack.

In this type of pack (Plates 233-238), the bananas are combined on a section of the flange of the hands in units of two to six bananas. The combination of clusters may vary throughout the pack, but it should be confined within the limits of two and six.

With the cluster pack, the bananas in combination should be as close and evenly fitting as possible. A hand that contains an even type of fruit (Plate 233) can easily be broken into clusters containing up to six bananas which will fit together firmly (Plate 284). An uneven type of hand (Plate 235) may need to be broken into smaller clusters of three or four bananas to ensure that the clusters fit snugly together when packed.

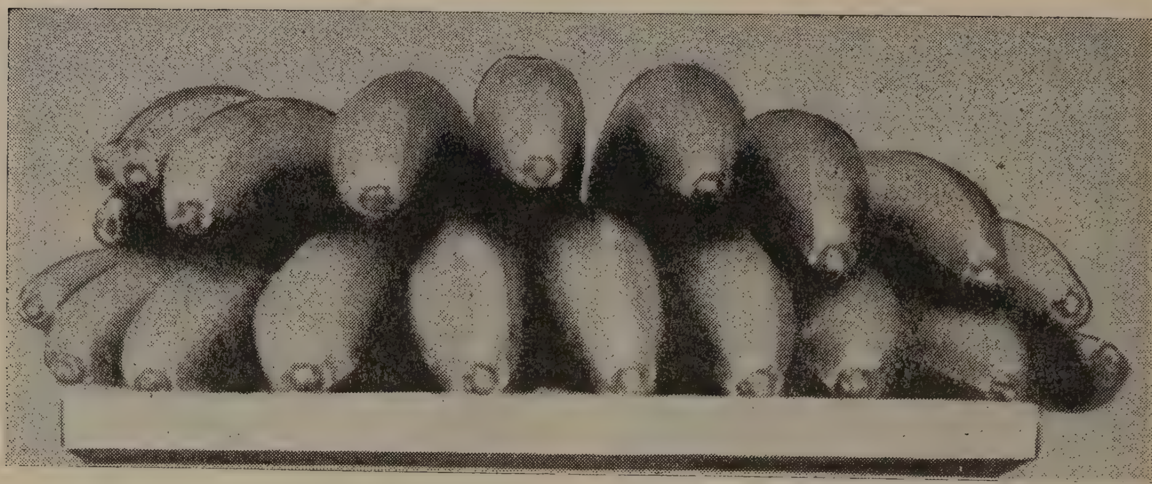


Plate 233.

Cluster Pack.—A hand of green fruit which is very suitable for breaking into clusters.

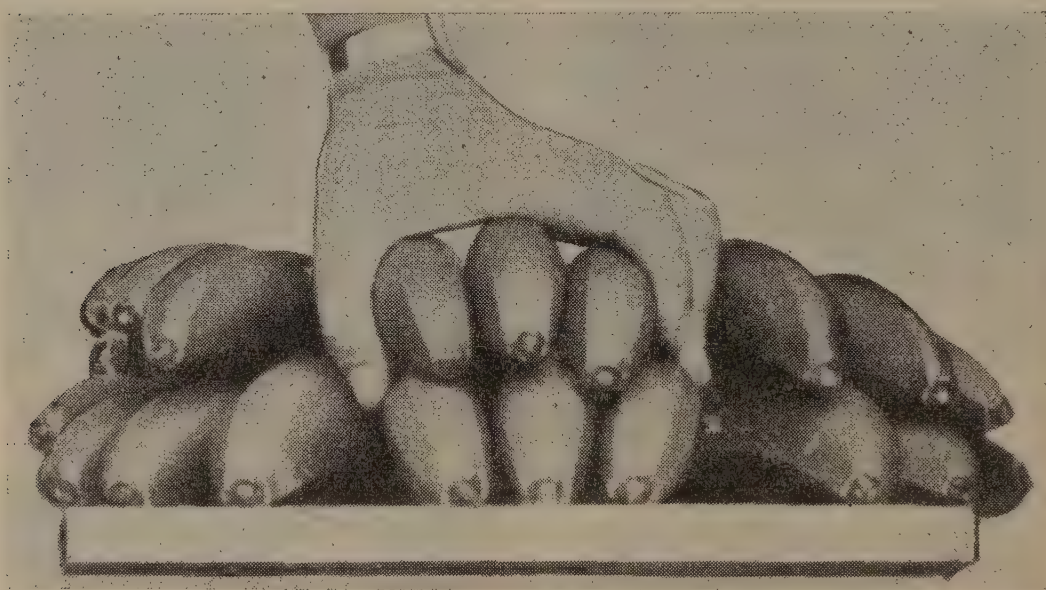


Plate 234.

Cluster Pack.—The same hand of fruit as in Plate 228, showing how the fruit will fit together when pressure is applied.

Plate 235.

Cluster Pack.—An uneven hand which would require breaking into smaller clusters of two or four.

In the placement of the bottom layer, careful attention should be given to the selection of clusters of even size in order to obtain a firm and straight line foundation for the neat and orderly construction of

Plate 236.
Cluster Pack.—Showing how the fruit is placed for the first layer.

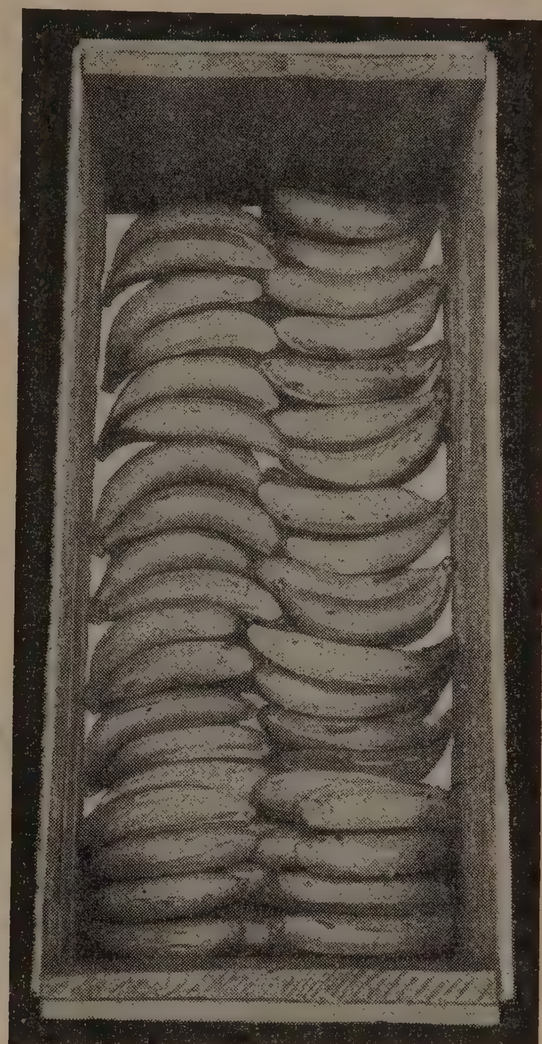


Plate 237.
Cluster Pack.—Starting the second layer.

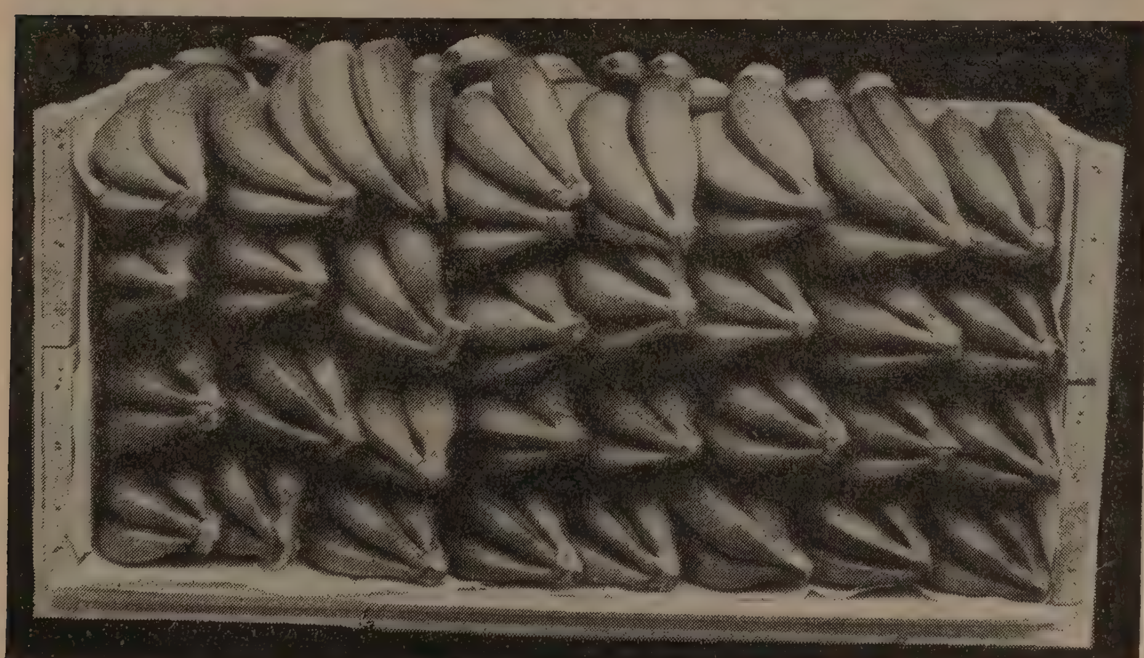


Plate 238.
Cluster Pack.—A completed pack. Owing to the large clusters used, this pack would be light in weight.

subsequent layers. With the first layer, the clusters are placed on their sides in two lines with the stalk ends against the sides of the case (Plate 236). The second and following layers are placed over the bottom layers with the concave side of the fruit downwards, and stalk ends must be placed well down the sides of the case as in the singles pack (Plates 237 and 238).

With small fruit, the central space should be filled in with small clusters of even-sized bananas placed in a vertical position.

Single bananas may be used to a very limited extent in finishing off the pack at the top of the case.

The cluster pack is approximately 5 lb. per case lighter than the singles pack, but bananas packed in clusters are not affected to the same extent with stalk end rots as are single fruits. Furthermore, the time taken in dehanding and packing clusters is less than half that required for the singles pack.

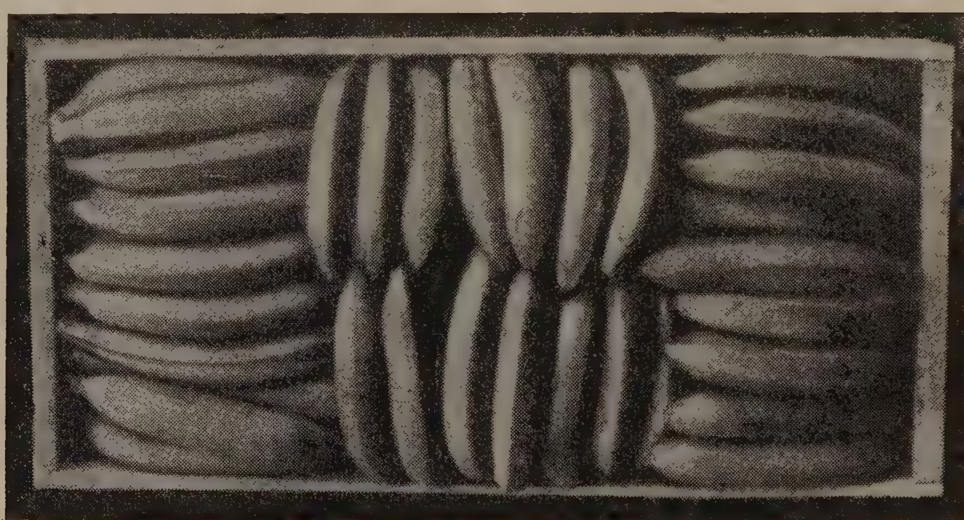


Plate 239.
Cluster Pack of Long Fruit.—Case with top removed.

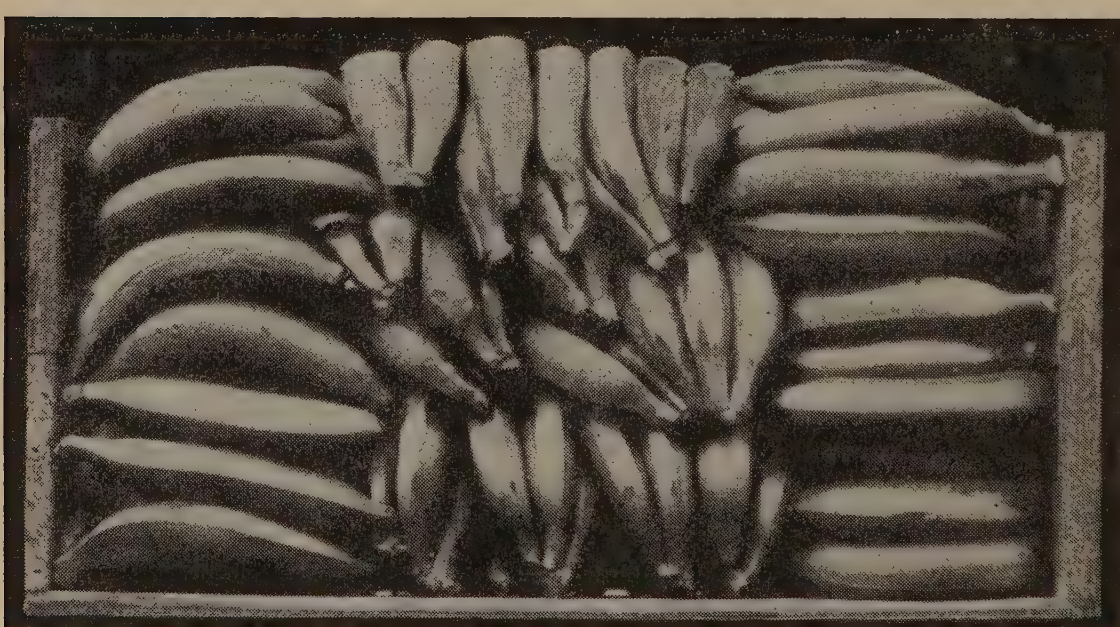


Plate 240.
Cluster Pack of Long Fruit.—Case with top and side removed.

Cluster Packs for Straight and Oversized Fruit.

Large long and straight long fruit present difficulties in packing. Experiments have shown that the easiest method is to pack the long clusters lengthwise in the case and fill in the middle (Plates 239 and 240). As far as possible, the better-shaped curved fruit are used for the centre, the straight being kept for the two ends.

The Full Hand Pack.

Bananas packed in full hands are presented to the consumer in better condition than is possible with singles and cluster packs.

The full hand pack is approximately 10 lb. lighter than the singles pack. The lighter weight is the main reason why this pack is not favoured by the trade.

In order to obtain a satisfactory full hand pack of reasonable weight, the method known as the flat pack is recommended (Plates 241-244). The hands should first be graded into groups of uniform size, and all broken, ripe, blemished and undersized bananas must be removed.

When cutting the hand from the bunch, a greater portion of the stem joining flange must be left on the hand than is the case for the singles pack (Plate 245). If a thin flange is left, the fruits will break off under pressure and the pack will then become a mixture of single, clusters, and part hand fruits.

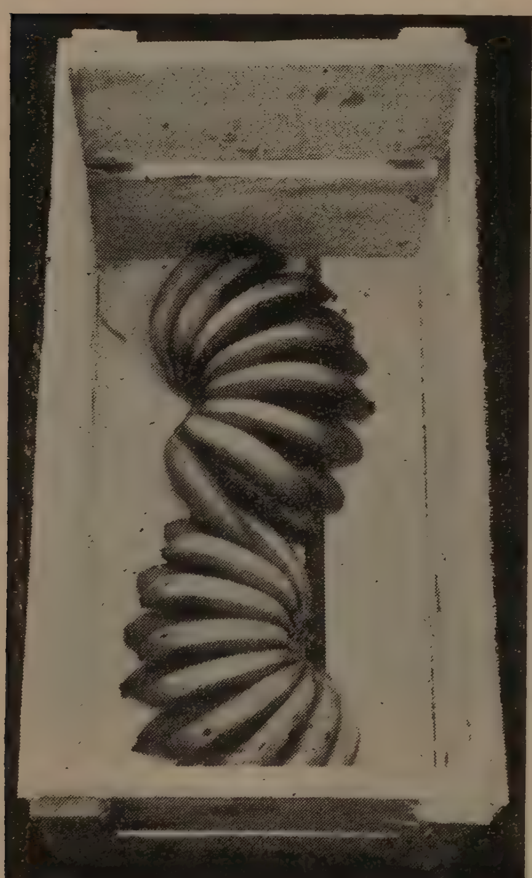


Plate 241.

Full Hand Pack.—First layer.

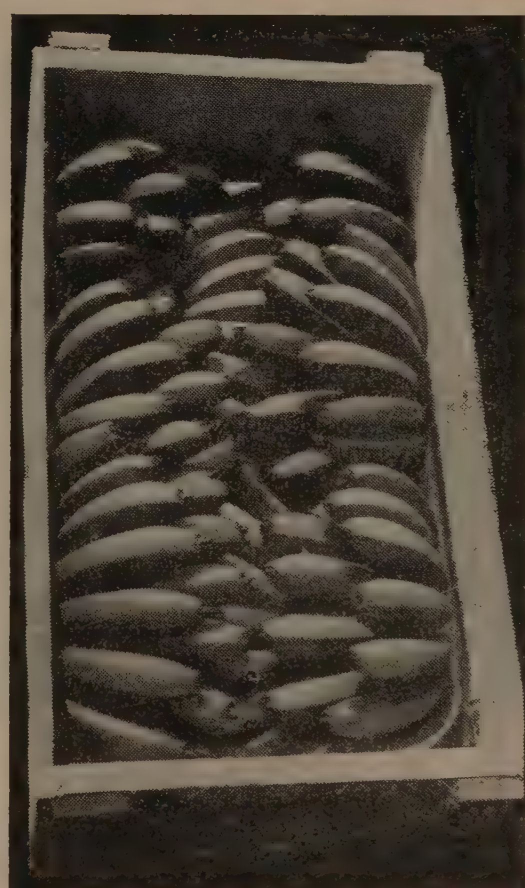


Plate 242.

Full Hand Pack.—Second layer.

Plate 243.
Full Hand Pack.—Third layer.

Plate 244.
Full Hand Pack.—Fourth layer. Fill-in clusters may be used where spaces occur in the pack, particularly on the top layer.

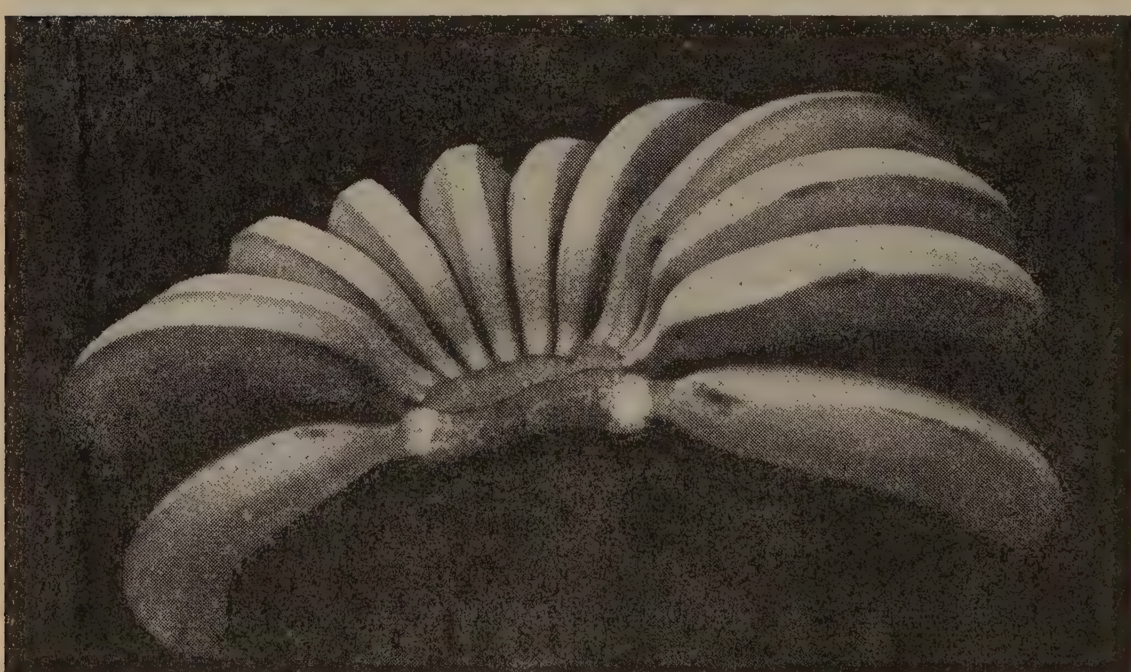


Plate 245.
Full Hand Pack.—Hand cut from the bunch stem, showing the thick flange necessary for the full hand pack.

PACKING LADY FINGER BANANAS.

The Lady Finger banana has increased considerably in popularity and the demand for this variety is becoming more extensive in southern States.

In the Brisbane and South Coast areas, where at present most Lady Fingers are grown, the fruit is invariably marketed in the bunch. For distant locations, the fruit is marketed in the standard banana case.

Owing to the comparatively small size, straight formation and somewhat angular shape of the Lady Finger banana, the fruit should be packed in full or part hands. The method of packing the fruit should be the same as for the Cavendish full hand flat pack.

In many instances, it will be found that the hands of bananas are uneven in the spacing between the fruits. This irregular arrangement of the bananas does not allow for compact placement in packing. Where this difficulty arises, it is advisable to divide the hand and separate the irregularly spaced fruit. These divided fruits may be packed into suitable compact positions within the main full hand arrangement.

THE STANDARD BANANA CASE.

Bananas are packed in the standard banana case with specifications as follows:—

Internal Measurements:—21 inches long, 12 inches wide, 12 inches deep.

Timber:—Hardwood (preferably flooded gum) or pine.

ENDS: 2 pieces, 6 x $\frac{3}{4}$ x 12 inches.

SIDES: 11 x 5/16 x 22$\frac{1}{2}$ inches, no piece to be under three inches in width.

TOPS and BOTTOMS: 12 x 5/16 x 22$\frac{1}{2}$ inches.

FUNGICIDAL TREATMENT FOR CASED BANANAS CONSIGNED INTERSTATE.

Cased bananas marketed in New South Wales and Western Australia between 1st May and 30th November in any year must be treated or dipped in a fungicide containing salicylanilide sufficient to kill the fungus which causes squirter disease in bananas. The package containing such bananas must be marked with the name of the fungicide followed by the word "treated" or "dipped" as the case may be.

CHANGE OF ADDRESS.

Journal subscribers notifying change of address should state their full Christian names and surname as well as their full former and new addresses.

Address all communications to the Under Secretary, Department of Agriculture and Stock, Brisbane.

TUBERCULOSIS-FREE CATTLE HERDS.

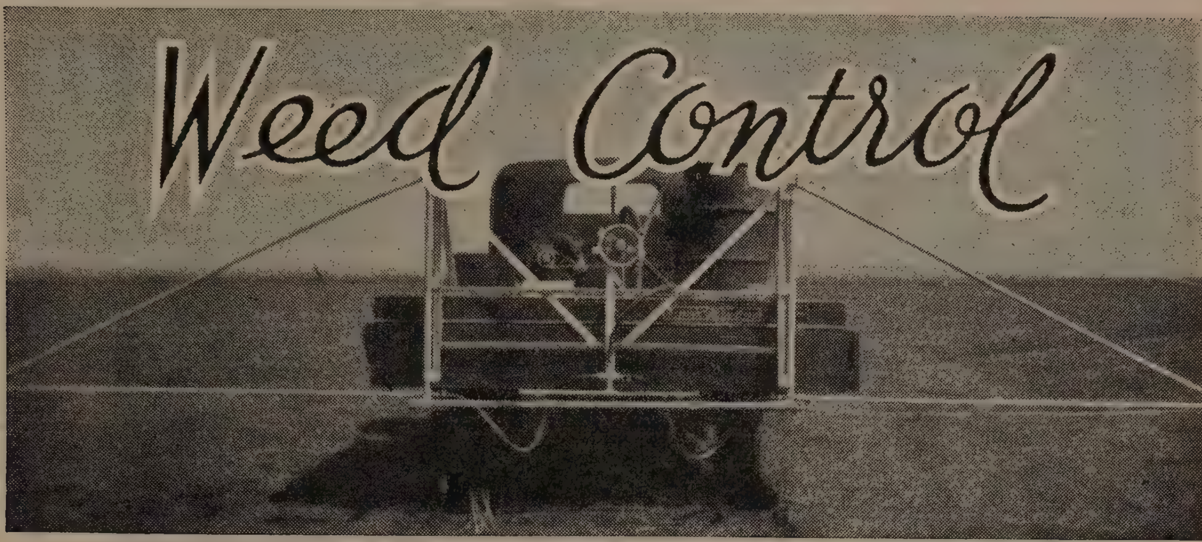
(AS AT 15th MAY, 1951.)

Breed.	Owner's Name and Address of Stud.
Aberdeen Angus ..	The Scottish Australian Company Ltd., Texas Station, Texas
	F. H. Hutton, "Bingegang," Dingo
A.I.S.	F. B. Sullivan, "Fermanagh," Pittsworth
	D. Sullivan, "Bantry" Stud, Rossvale, *via* Pittsworth
	W. Henschell, "Yarranvale," Yarranlea
	Con. O'Sullivan, "Navillus Stud," Greenmount
	H. V. Littleton, "Wongalea Stud," Hillview, Crow's Nest
	J. Phillips and Sons, "Sunny View," Kingaroy
	Sullivan Bros., "Valera" Stud, Pittsworth
	Reushle Bros., "Reubydale" Stud, Ravensbourne
	H. F. Marquardt, "Chelmer," Wondai
	W. G. Marquardt, "Springlands," Wondai
	A. C. and C. R. Marquardt, "Cedar Valley," Wondai
Ayrshire	L. Holmes, "Benbecula," Yarranlea
	J. N. Scott, "Auchen Eden," Camp Mountain
Friesian	C. H. Naumann, "Yarrabine Stud," Yarraman
	J. F. Dudley, "Pasadena," Maleny
Jersey	W. E. O. Meier, "Kingsford Stud," Rosevale, *via* Rosewood
	J. S. McCarthy, "Glen Erin Jersey Stud," Greenmount
	J. F. Lau, "Rosallen Jersey Stud," Goombungee
	G. Harley, Hopewell, Childers
	Toowoomba Mental Hospital, Willowburn
	Farm Home for Boys, Westbrook
	F. J. Cox and Sons, "Rosel" Stud, Crawford, Kingaroy Line
	R. J. Browne, Hill 60, Yangan
	P. J. L. Bygrave, "The Craigan Farm," Aspley
	A. Verrall and Sons, "Coleburn Stud," Walloon
	R. J. Crawford, ' Inverlaw Jersey Stud," Inverlaw, Kingaroy
	P. H. F. Gregory, "Carlton," Rosevale, via Rosewood
	E. A. Matthews, "Yarradale," Yarraman

USE OF ALUMINIUM BUILDING MATERIALS.

During recent months a number of primary producers have made enquiries regarding the corrosive effects of galvanised iron and other materials on aluminium sheets used for roofing purposes. Direct contact between aluminium and other metals, green hardwoods, concrete or mortar should be prevented by the use of bituminous paint or felt. Fixings, if not of aluminium or cadmium-plated steel, should be used only in conjunction with bituminous felt or impregnated fibre washers.

A leaflet entitled ''Aluminium in Building'' is obtainable free of charge from The Building Research Liaison Service, P.O. Box 2807AA, Melbourne, Victoria.



Russian Knapweed—Declared a Noxious Plant.

S. L. EVERIST, Botanist.

RUSSIAN knapweed (*Centaurea repens*) was recently declared a noxious weed throughout the State. This note is issued to allow those interested to identify the plant.

Description.

Perennial with many woody underground stems and roots which are almost black in colour; leaves and stems silvery grey becoming dull grey-green with age; rosette leaves (Plate 246) 2-3 inches long,

Plate 246.

Russian Knapweed Plant in the Rosette Stage.

1-2 inches broad, deeply but irregularly divided into blunt lobes; stems erect from centre of rosette, slender and rather woody, branched freely in the upper part; stem-leaves alternate, lower ones like those of the rosette, upper ones becoming smaller and less toothed towards the top; each branch ending in an oval flower head about ½ inch broad with a tuft of mauve or pale pink flowers emerging from the top; flower heads like small spear thistles in shape and colour but without prickles; ripe seed heads tightly closed and seeds not shed.

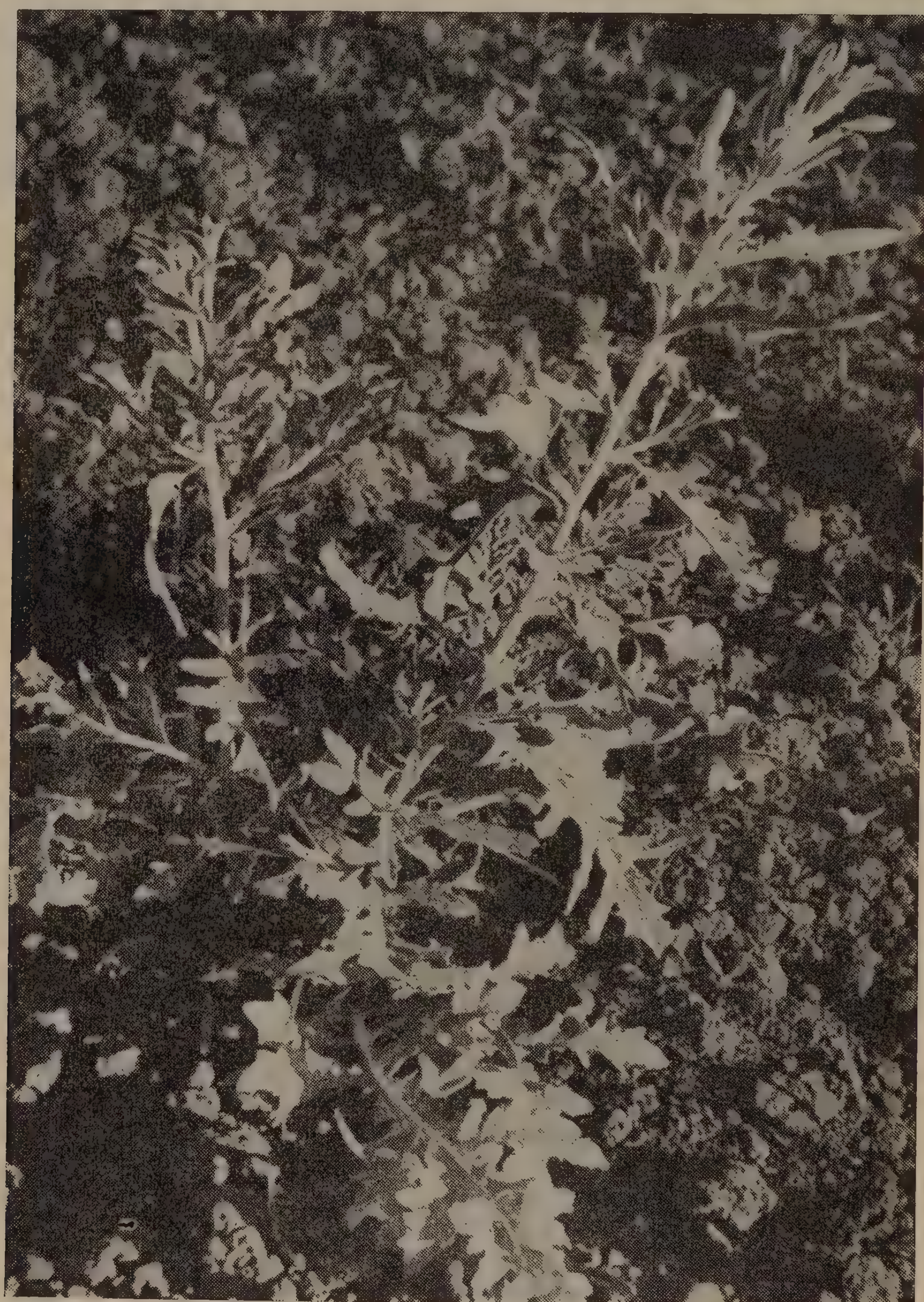


Plate 247.

Russian Knapweed in the Pre-flowering Stage.

Distribution.

Russian knapweed, sometimes called creeping knapweed, is a native of Turkestan in southern Russia. It is a serious weed pest in many countries but in Queensland so far has been found only in several places on the Darling Downs, growing in soils ranging from light brown loam to heavy clay.

Properties.

In Canada the weed is reported to grow very rapidly, one root having produced a patch with a diameter of 61 feet in two years. Observations indicate that under Queensland conditions the rate of spread is not so rapid and mostly takes place in years with wet winter and spring months. The plant is dormant during the winter, but in the early spring new shoots come up from the old roots. Because of its extensive system of underground runners, the plant retards growth of summer crops such as Sudan grass and if infestation is thick practically suppresses them altogether.

Control.

Eradication of Russian knapweed is difficult. Cultivation appears to encourage its growth. It also has the disadvantage that pieces of the roots break off and are carried on implements to clean areas. Overseas, acid arsenicals have been used to control it, but arsenical preparations have not been successful here. Sodium chlorate kills the tops but regrowth is often considerable. Preliminary experiments indicate that it may be possible to control the weed by cultivating in the spring, then spraying the rosettes with 2,4-D or 2,4-D/2,4,5-T mixtures at the rate of 2 lb. active ingredient per acre. Further work is needed to confirm this.

CATTLE ADVISERS IN CENTRAL DISTRICT.

The cattle industry in Central Queensland should gain considerably by a recent extension of the Department's services to producers in that area, the Minister for Agriculture and Stock (Honourable H. H. Collins) said recently.

Realising the importance of the Central District as a cattle producing centre, the Department had transferred Mr. J. G. Young (Husbandry Officer, Cattle Husbandry Branch) from Departmental headquarters in Brisbane to the Central District, with headquarters at Emerald. Mr. Young, in addition to carrying out important research and advisory work for the further improvement of the beef cattle industry, would supervise the work of other Branch officers in the district.

Another recent appointment had been that of Mr. J. Arbuckle (Adviser in Cattle Husbandry) to Rockhampton. His chief work would be to advise beef and dairy cattle producers on the Central Coast on husbandry problems and he would also be associated with experimental work being carried out by the Branch in the area. Mr. Collins said that Mr. Arbuckle had just had two years' practical experience of the industry on Spring Creek station, Mt. Surprise, followed by a period at the Bureau of Tropical Agriculture, South Johnstone, where he gained knowledge of cattle production problems on the tropical coast. Another adviser (Mr. J. J. Sullivan) has been stationed at Clermont for some time.

Yet another transfer has been that of Mr. K. Howard (Field Assistant, Cattle Husbandry Branch) from Brisbane to Cullin-la-ringo to supervise the beef cattle feeding trials being jointly carried out there by the Department and the Queensland-British Food Corporation.

Mr. Collins said that in addition to the staff at headquarters in Brisbane the Cattle Husbandry Branch now had eight officers stationed in various parts of the State.

Improved Herd Production as Shown by Herd Recording.

S. E. PEGG, Senior Adviser (Herd Recording).

NUMEROUS instances have been noted of improvement in production of herds being recorded in the Group Herd Recording Scheme of the Department. This improved production emphasises the fact that farmers are making intelligent use of the information provided by herd recording.

The following is a summary of the information supplied to members of the scheme.

Herd Record Sheet.

The herd record sheet is handed to the member by the herd recorder as soon as he has recorded the production of the cows in the herd at each monthly visit. This sheet gives for each cow in the herd the amount of milk produced in the evening and the morning, the total yield of milk and butterfat for the day, the percentage of fat in the milk, and the estimated amounts of milk and butterfat produced in a 30-day period.

The information on this sheet enables the herd owner to ascertain the progressive production month by month of each cow in the herd and her response to the system of management. It is particularly useful to a farmer who is practising supplementary feeding, as it enables him to make better use of the available foodstuffs by feeding each cow according to her production.

The Monthly Summary.

On receipt of the herd record sheet at the Department's Head Office, the total daily amount of milk and butterfat produced by the herd and the average daily production per cow are compiled.

At the end of each calendar month the average production per cow for each herd recorded is entered on a monthly summary sheet for each group, together with the average production for all the cows recorded in the group during the month, and the results forwarded to each member of the group.

The anonymity of each member is preserved by allocating an index letter to each herd. This letter is altered each month.

The monthly summary allows the member to compare the production of his herd with that of others in the same district, as well as with the average for the district. If the average production of the herd is below the average for the district, the interested owner would be expected to seek the reason for the low production.

Lactation Returns.

As cows dry off the production of each for the lactation period is forwarded to the member. This allows him to compare the productive capacity of the various cows in the herd.

Herd Average.

At the end of the herd recording year, each member is given the average production of cows in various age groups in his herd, as well as the average of the whole herd. On the same form is given similar information regarding the average production for the whole group, thus allowing him to form a comparison.

Example of Herd Improvement.

The foregoing information has stimulated interest among many farmers in better farming methods, which have led to increased production per cow and per acre.

From many such instances noted, one herd has been taken as an example, and in Table 1 the average daily production of butterfat per cow per month since the herd was first recorded, the number of cows milked each month and the total production of butterfat for each month are given.

TABLE 1.

PRODUCTION RECORDS FOR A SELECTED HERD.

Month.	1948. No. of Cows.	1948. Butterfat Production. Average Daily per Cow.	1948. Butterfat Production. Total.	1949. No. of Cows.	1949. Butterfat Production. Average Daily per Cow.	1949. Butterfat Production. Total.	1950. No. of Cows.	1950. Butterfat Production. Average Daily per Cow.	1950. Butterfat Production. Total.
		Lb.	Lb.		Lb.	Lb.		Lb.	Lb.
January ..	..	..	..	79	·502	1,190	81	·703	1,709
February ..	60	·792	1,426	82	·518	1,275	83	·790	1,966
March ..	71	·602	1,282	84	·695	1,752	88	·723	1,908
April ..	75	·519	1,168	88	·595	1,568	91	·755	2,063
May ..	76	·373	850	84	·526	1,327	84	·749	1,888
June ..	88	·508	1,007	88	·539	1,424	88	·698	1,843
July ..	92	·434	1,198	92	·602	1,660	86	·613	1,582
August ..	61	·561	1,027	92	·651	1,796	79	·624	1,479
September..	66	·508	1,007	95	·619	1,765	93	·722	2,014
October ..	69	·534	1,105	84	·656	1,653	88	·717	1,893
November	72	·469	1,013	92	·777	2,144	81	·836	2,031
December ..	76	·548	1,250	88	·749	1,977	85	·900	2,296
Total ..	..	..	12,333 (11 months)	..	..	19,531	..	..	22,672
Average ..	73·3	..	1,121	87·3	..	1,628	85·5	..	1,889

This farm consists of 350 acres, of which an area is cultivated for fodder for the milking cows and the remainder used for depasturing the milking cows and calves. The dry cows are run on a separate area of 200 acres, giving a total area of 550 acres.

1948.—It will be noted that for the 11 months to 31st December, 1948, the total amount of butterfat produced was 12,333 lb., or an average of 1,121 lb. per month. The average production per acre per year was 24.46 lb. butterfat, the average production per cow 183.5 lb. and the average number of cows milked per month 73.3.

1949.—For the 12 months to 31st December, 1949, a total of 19,531 lb. butterfat was produced, with a monthly average production of 1,628 lb. The average butterfat production per acre for the year was 35.51 lb., the average production per cow 223.7 lb., and the average number of cows milked per month 87.3.

1950.—The total production again increased for the 12 months to 31st December, 1950, when it was 22,672 lb. butterfat with an average monthly production of 1,889 lb. The average production per acre rose to 40.13 lb. butterfat, and the average production per cow to 265.2 lb., with an average of 85.5 cows being milked each month.

The increase in the average production per acre for 1950 over that in 1948 was 15.67 lb. butterfat, an increase of 64 per cent. At 3s. per lb. this represents an increased yearly income of £1,292 14s. During the same period the average production per cow increased from 183.5 lb. butterfat to 265.2 lb., an increase of 44.5 per cent.

It is realised that seasonal conditions could have played some part in this increased production, but the greater part is probably due to an increasing interest in improved farming and husbandry methods following on the production recording of the herd.

From the foregoing it can be concluded that some farms at least are capable of greatly increasing production per acre, per cow and per year, and that the information provided by the Group Herd Recording Scheme greatly assists members to achieve these increases.

Herd improvement is a long-range project which should be approached by farmers in the following manner:—

The first year's results test the methods of the farmer.

The second year's results test the herd.

The third year's results cull the herd.

The fourth year's results build the herd.

The fifth and succeeding year's prove the bull.

Some Aspects of the Economics of Milk Production.

R. W. HEWETSON and R. D. CHESTER, Cattle Husbandry Branch.

THE rational approach to the feeding of cows for milk production is to attempt to supply a ration balanced in energy, protein and mineral content for the volume of milk produced.

A farmer's ability as an efficient feeder is measured by his capacity to adjust the cost of feeds in relation to the value of milk produced so that the difference between costs and returns will be as great as possible. This means striking a balance between not feeding supplements at all, on the one hand, and feeding cows to the maximum of their production capacity on the other. Generally, it will be necessary to feed a variety of feeds, most of which are home-grown, to cows selected for their production ability so that each cow produces a fairly high yield of milk.

To make the most effective use of feed, the farmer must get a large amount of milk from each of his cows. The high-producing cow is more efficient and therefore more economical as a converter of feed to milk than is the low producer. Maintenance requirements for both the high producer and the low producer are the same, but in the case of the high producer, maintenance costs are relatively cheaper because of the greater overall returns.

When planning a programme of heavy supplementary feeding, the farmer should also embark on a programme of breeding for high production and be prepared to cull out low producers from the herd. Each cow's capacity to produce milk is limited by certain inherited factors. Feeding for production above the inherited maximum will not result in increased output of milk and the extra feed will therefore be wasted.

The Importance of Home-grown Roughage.

Under Queensland conditions, production of milk or other dairy produce depends largely on the roughage feeds and profits will be large or small according to the ability of the farmer to himself produce suitable home-grown roughages and to supplement them with such concentrates as can be obtained reasonably cheaply.

Good results will most often be obtained when the value of large amounts of good quality roughages is realised. Generally, cows should have available as much good quality roughage as they can eat. It is not sound thinking to hope that cows getting insufficient roughage to fill the paunch can be made to produce profitably by the addition of a few pounds of concentrate to the ration. However, high producers are incapable of eating sufficient roughage for maximum production and some supplementary feeding with concentrates may be necessary if the most profitable level of production is the aim of the farmer.

All dairy cows therefore should be fed all the hay and/or silage, plus grazing, that they can eat.

The best grazing is young green crops or fresh green pastures. Cows will eat up to 150 lb. of green matter a day but limited access will greatly reduce this amount and allowance must be made for this

fact in computing rations. As crops and pastures mature, their feeding value decreases and it becomes increasingly important to feed concentrates containing more protein.

With a gross shortage of protein in Queensland, every effort should be made to produce as much protein as possible on the farm.

Protein rich crops include lucerne, field peas, cowpeas and summer and winter grazing crops such as Sudan grass, millets, oats, wheat and canary seed.

Good quality legume hay is the best type of hay to use. It contains the same energy equivalent as good cereal or grass hay, but is richer in minerals and in protein, this latter quality being of particular importance in Queensland, where frequently protein intake limits production. However, cereal hays are quite suitable for dairy cows provided they are supplemented by the right type of protein-rich concentrate.

Silage is an excellent roughage feed, but it should not be used as the only source of roughage. However, if fed at the rate of about 3 lb. per day for each 100 lb. bodyweight it forms a very good supplement for feeding with pasture or hay. Silage may taint milk if fed immediately before milking. If this occurs, an alteration in the feeding routine should be made to ensure that all silage is fed at least two hours before the cows are milked.

If milking cows are likely to be fed on milk tainting fodders it is a good practice to allow access to these feeds immediately after milking only and not before.

Choosing Concentrates to Supplement Roughage.

The roughage supplied will usually be that most easily and most economically grown on the farm. Having supplied cows with adequate roughage, the farmer must then turn his attention to the concentrate supplement to be fed in order to maintain a good milk yield. It is necessary to decide just what ingredients will be incorporated in the concentrate mixture. Having done this, it is then time to assess the rate at which to feed the mixture. These decisions will be guided by:—

(*a*) Kind and quality of roughage fed.

(*b*) Milk production of each cow.

(*c*) Costs of various concentrate feeds.

(*d*) Price obtained for dairy produce.

The protein content of the concentrate will be determined by the type of roughage fed. Having decided the protein requirements, the farmer then must seek the cheapest combination of ingredients which will give a final concentrate mixture of the required protein content.

The character of the cow and her feed capacity should be studied. Some cows have the ability to eat larger quantities of feed than others and so will make use of more home-grown roughage and require less purchased concentrate. Feeding too much grain and sudden changes from roughage to grain feeding should be avoided, as they will cause serious "feed sickness" and a corresponding reduction in yield.

Changing Feed.

From time to time difficulty will be experienced with unpalatability of certain feeds, such as bloodmeal and meatmeal. Unpalatable feeds should be introduced slowly so that cows gradually become used to them.

Mixtures containing a large number of ingredients have a small advantage because of the fact that ingredients can be included or excluded without affecting the palatability of the mixture.

In order to feed with some degree of accuracy, it is necessary firstly to know within fairly accurate limits just what is the production of individual cows. It is then necessary to feed cows individually or in groups of cows of about the same production.

It is wasteful to feed a whole herd on the same basis. By this method, the higher producer gets too little feed and as a result her production is reduced, and the low producer gets too much feed, for which there is no compensating lift in production.

It is convenient to keep a chart in the dairy with each cow's name, her approximate daily production and the amount of concentrate to be fed:—

Name.	Production. Lb. of Milk.	Concentrate. Lb. per Day.
Belle	15	2
Beatrice	20	4
Buttercup	25	6

Provided roughage can be produced on the farm, it will be a cheap form of feed, and in these circumstances should be fed to the maximum possible limit. On the other hand, in dairies where roughage is purchased on the open market, it will frequently be more expensive per food unit than are concentrate foods. In such cases a different approach to rationing is necessary and the amount of roughages must be decreased and concentrates increased according to prices. Roughage should not be dropped below the equivalent of 10 lb. of hay daily because of the possibility of indigestion when large quantities of concentrate are fed with little roughage.

Where roughage is cheap, therefore, cows should be given constant access to this class of food.

TABLE 1.

Type of Roughage.	Percentage of Protein Necessary in Concentrate.	Typical Concentrate Mixture.
Lucerne Hay	10—12	Grain alone, or grain plus mill offals
Other Legume Hay of Choice Quality	10—12	Grain alone, or grain plus mill offals
Young Green Cereals, Choice Pasture	10—12	Grain alone, or grain plus mill offals
Mixture of Legume and Cereal Hay	14—16	Grain .. 3 parts
Legume Hay and Sorghum Silage	14—16	Pollard .. 1 part
More Mature Green Crops (Cereal or Sudan Grass or Millet)	14—16	Bran .. 1 part
Good Quality Pasture	14—16	Linseed Meal .. 1 part
Cereal Hay	18—20	Grain .. 3 parts
Fair Quality Pasture	18—20	Bran .. 2 parts
Mature Green Crops	18—20	Linseed Meal .. 4 parts
Mature Pasture	24	Grain .. 3 parts
Cowcane	24	Bran .. 2 parts
Sorghum Silage	24	Meatmeal .. 2 parts

Table 1 sets out the protein percentage required in the concentrate mixture for feeding with various forms of roughage. This table is an adaptation of one by T. E. Woodward in the United States Department of Agriculture Year Book for 1939.

Because the protein content of the roughages will vary somewhat according to their stage of development at harvesting and according to the efficiency with which the original crops are conserved, the table should be interpreted liberally and adjustments made according to the quality as well as the type of roughage.

Suggested Concentrate Mixtures.

The following meals are given as suitable concentrate mixtures of the correct protein content for the various roughages as set out in Table 1.

Mixtures containing 14 *to* 16 *per cent. protein.*

(1)	Crushed oats	4 parts
	Cracked corn	4 „
	Meatmeal	1 „
(2)	Crushed oats ..	1 part
	Crushed sorghum	2 „
	Linseed meal ..	1 „
(3)	Crushed sorghum	3 parts
	Crushed corn ..	3 „
	Cottonseed meal ..	1 „
(4)	Crushed oats ..	2 parts
	Crushed corn ..	2 „
	Crushed sorghum	2 „
	Peanut meal ..	1 „

Mixtures containing 18 *to* 20 *per cent. protein.*

(1)	Crushed corn ..	2 parts
	Crushed sorghum	1 „
	Bran	1 „
	Pollard	1 „
	Peanut meal ..	2 „
(2)	Crushed sorghum	3 parts
	Crushed oats ..	2 „
	Crushed corn ..	2 „
	Meatmeal	2 „
(3)	Crushed oats ..	1 part
	Crushed corn ..	2 „
	Linseed meal ..	2 „
(4)	Crushed sorghum	5 parts
	Crushed maize ..	5 „
	Linseed meal ..	3 „
	Peanut meal ..	2 „

Mixtures containing 24 *per cent. protein.*

(1)	Crushed corn ..	1 part
	Crushed Oats ..	1 „
	Bran	2 „
	Peanut meal ..	2 „
	Linseed meal ..	4 „
(2)	Crushed corn ..	9 parts
	Crushed oats ..	4 „
	Meatmeal	7 „
(3)	Crushed corn ..	6 parts
	Crushed sorghum	6 „
	Crushed oats ..	3 „
	Bran	5 „
	Pollard	5 „
	Peanut meal ..	6 „
	Meatmeal	8 „
(4)	Crushed corn ..	4 parts
	Crushed sorghum	4 „
	Cottonseed meal ..	7 „

Estimating Amount of Concentrate to Feed.

In feeding the concentrate, it is convenient to estimate the amount to be fed on a per-gallon-of-milk-produced basis. That is, if concentrate is to be fed at 1 lb. per gallon, the cow producing three gallons of milk will receive 3 lb. of concentrate, and so on.

However, some adjustment should be made for the butterfat content of milk. More energy and protein are required to produce milk with a high butterfat test. Milk can be adjusted to 4 per cent. fat or a breed allowance can be made. Those breeds having a higher average test, such as Jerseys and Guernseys, may be fed at a higher rate per gallon than the lower testing Australian Illawarra Shorthorn, Ayrshire and Friesian breeds.

Selection of Concentrate and Grain to Feed.

By consulting Table 2, which sets out the average food unit value and digestible crude protein content of the commonly available concentrates, the farmer should be able to substitute one concentrate for another in any of the mixtures given, if the constituents for the original meal are not readily available.

TABLE 2.

FODDER VALUES OF COMMONLY USED CONCENTRATES.

—	Average Food Units per 100 Lb. (Starch Eqiuvalent).	Digestible Crude Protein per 100 Lb.
	Protein-rich Concentrates.	
Blood Meal	63 (say 65)	68
Meatmeal	77 (say 75)	54
Peanut Meal	78 (say 80)	43
Cottonseed Meal	67 (say 65)	33
Linseed Meal	72 (say 70)	25
	Carbohydrate-rich Concentrates.	
Maize Grain	77 (say 75)	8
Wheat Grain	72 (say 70)	8
Oat Grain	61 (say 60)	8
Sorghum Grain	76 (say 75)	7
Bran	56 (say 55)	10
Pollard	66 (say 65)	10
Molasses	50 (say 50)	Nil

In any case, these mixtures should only be taken as guides and alterations must be made according to the price of the various ingredients if the most profitable level of feeding is sought.

Generally, price per food unit and price per pound of protein will determine the particular concentrate to be used, though factors of palatability and texture must be considered.

It is, where possible, preferable to feed a mixture of grains rather than one particular grain, but this general rule may be ignored if one type of grain is very much cheaper than others. For instance, if a farmer can produce sorghum grain on the farm at a low price it would be unwise for him to purchase other grains on the open market to mix with his sorghum grain just for the sake of feeding a better balanced grain mixture.

In selecting grains, therefore, the choice should be made according to cost per food unit.

In selecting protein-rich concentrates, the choice will be determined by the cost per pound of protein rather than the cost per food unit, as generally these concentrates are fed in order to build up the protein percentage of the ration, though of course, at the same time, they do replace part of the energy-rich concentrate in the ration.

Estimating Cost of Grain.

The following is suggested by H. J. Geddes of the Sydney University as a convenient method of estimating the cost per food unit of each grain from the price per bushel.

The Cost per Food Unit is equivalent to—

$$\frac{\text{Cost per bushel}}{\text{Weight per bushel}} \times \frac{100}{\text{Starch Equivalent of Grain}}$$

The factors "weight per bushel" and "starch equivalent" of any particular grain are constant. Therefore, the factor

$$\frac{100}{\text{Weight per bushel} \times \text{Starch Equivalent of Grain}}$$

is constant for a particular grain and may be expressed as a constant figure, namely:—

Sorghum .. .. 1/46 $\left(\text{that is } \frac{100}{60 \times 76}\right)$

Wheat .. .. 1/43 $\left(\text{that is } \frac{100}{60 \times 72}\right)$

Maize .. .. 1/43 $\left(\text{that is } \frac{100}{56 \times 77}\right)$

Barley .. .. 1/36 $\left(\text{that is } \frac{100}{50 \times 71}\right)$

Oats .. .. 1/24 $\left(\text{that is } \frac{100}{40 \times 61}\right)$

The following is an illustration of the use of this method using hypothetical bushel prices:—

Grain.	Cost per Bushel.	Constant Factor.	Cost per Food Unit.
	s. d.		*d.*
Sorghum	5 9	46	1·5
Wheat	7 2	43	2·0
Maize	9 0	43	2·5
Barley	4 6	36	1·75
Oats	6 0	24	3·0

Thus, at the prices per bushel given, the farmer would feed as much sorghum as possible and avoid the use of maize and oats.

Most protein-rich concentrates are sold on a per ton basis. In order to work out the cost per pound of protein, it is necessary to know the protein percentage and to estimate the price per 100 lb. from the price per ton. Then divide the cost per 100 lb. by the protein percentage. Thus peanut meal with a protein content of 45 per cent. at 15s. per 100 lb. costs 4d. per lb. protein.

Mineral Requirements.

Some consideration should be given to the mineral content of the concentrate ration. The chief minerals which require attention are lime, phosphate and salt.

For milking cows, it is desirable to add 1 per cent. of salt to all mixtures in order to avoid the risk of deficiency.

Most concentrate mixtures, especially those containing a high proportion of grain, are low in lime and relatively rich in phosphates, and in cases where the lime content of the roughage is not likely to be high 2 per cent. of ground limestone should be added to the mixture. However, where large amounts of legume roughage are fed, adequate lime will be available from that source and there will be no need for addition of limestone to the concentrate portion of the ration.

In many parts of Queensland, pastures are deficient in phosphate and in most cases farmers cannot afford to feed concentrates except in limited quantities; in such cases, bonemeal should be added to the concentrate mixture to ensure that cows take from 1½ to 2 oz. of bonemeal per day. Bonemeal, fed in this way, is to be preferred to cattle licks.

Phosphorus can also be supplied to cattle by making use of superphosphate. This should be prepared by adding 2 lb. of superphosphate to one gallon of water, stirring well and allowing the residue to settle, only the clear fluid portion being used. This quantity can be added to 100 gallons of drinking water where cattle are watered by trough or it can be added to the daily feed at the rate of half a pint per cow if cattle are hand fed.

VALUE OF OUR BIRDS.

Most Queensland birds have a value in controlling insect pests which far outweighs the occasional economic losses they cause to farmers.

This is one of the main reasons for legislation which protects birds from indiscriminate destruction, for field, orchard and forest pests could be very much more serious if they were not subjected to bird attack.

The Science Branch of the Department of Agriculture and Stock has listed a number of particularly useful birds, such as the ibis, which eats white grubs, locusts and armyworms, and the magpie lark or "peewee," which is often seen searching newly ploughed land for the pupae of cutworms and armyworms, wireworms and other insects which live in the soil.

The flycatchers eat mainly flies and small beetles, which fall easy prey to these darting foragers. One member of this family is the willie wagtail, so often perched on cattle, from which it ranges to catch many insect enemies of man and beast. Many other small birds feed on aphids, others favour scale insects, while most of them destroy small insects.

Of the larger birds which are helpful in pest control, the owls (including the mopoke) generally prey on mice and large insects. Hawks and kestrels prefer a diet of cicadas, locusts, mice and lizards.

Other species of economic importance include frogmouths, wood swallows, cuckoo shrikes, currawongs, magpies, kingfishers and honeyeaters.

The few birds which have undesirable habits do not on the whole occasion much damage, and opposition to bird protection based on these few birds is quite unjustifiable.

Large areas in Queensland are sanctuaries in which no bird or other animal life, apart from pests, may be taken, but the Department wishes it to be more widely known that even outside sanctuary areas many birds are protected.

THE FARM HOME.

Treating a Cold.

A COLD in a baby or young child may lead to a serious illness and the most effective way to prevent this is to guard baby against the risk of catching colds.

If in spite of all your precautions baby develops a cold it must be treated at once. All colds are infectious and so a child with a cold should be isolated as much as possible from the rest of the family. Babies and young children react to infection by a cold differently from adults, and in most cases have some degree of fever. For this reason they should be put to bed and kept comfortably warm. The bedclothes should be light as well as warm and if a hot water bag is used on very cold nights great care must be taken that the stopper is fixed on tightly and the bag is well protected with a thick woollen cover.

There is no known ''cure'' for the common cold and no certain means of shortening its course. Therefore it is not recommended that medicines be given. The use of sulpha drugs and the common practice of dosing with ''opening medicines'' are mentioned only to be condemned. They cannot do any good. Anti-histamine drugs have been tried and have proved disappointing in both prevention and treatment of colds.

Rubbing a young baby's chest with some volatile substance is of doubtful benefit and sometimes produces a rash, especially on sensitive skins.

The most we can do in the treatment of colds is to protect the child from the risk of complications such as bronchitis and pneumonia, and to relieve as much as possible the discomfort a cold causes.

In young babies the cold takes the form of a ''running nose'' rather than a cough, although, of course, both can occur together. Some simple nasal drops are often all that is necessary. Soft old cotton rags should be used for handkerchiefs and then burnt and a little cold cream or vaseline smeared round the nose may prevent soreness. Blocking of the nose due to nasal discharge creates a problem when the child is sucking and *gentle* attempts should be made to clear the nasal passages with a pledget of cotton wool slightly moistened with warm water before starting to feed baby. If the cold makes baby very restless a small dose of aspirin may be helpful. Care should be taken not to exceed the recommended dose.

Some loss of appetite often accompanies a cold, and although it is necessary to give baby sufficient nourishment, no attempt should be made to force him to take food, as this will often start a feeding difficulty.

The toddler will only require a simple diet such as milk, hot or cold as preferred, well cooked cereals with milk, boiled or poached eggs, soft vegetables mashed through a strainer, simple puddings and fruit drinks at regular intervals.

The old-fashioned remedy of a warm lemon drink sweetened with honey does help to soothe the dry throat passages in the case of a toddler and is particularly useful at night.

A slightly higher pillow may be useful if the child has any difficulty in breathing.

A baby or child with a cold needs plenty of fresh air but direct draughts should be avoided. The windows should be open, but if necessary an improvised screen should be used at the top of the bed. When the child sits up in bed the upper part of his body should be protected with an additional woolly. A quick, warm sponge should be given daily.

If baby screams and puts his hands to the side of his head and rolls his head from side to side or pulls at his ear he may have earache, which is a common complication of a cold. The doctor should be called without delay and the same applies if the child continues to have a high fever or complains of pain in his chest or upper abdomen. A watchful mother soon knows if her baby has become really ill and will wisely seek medical help at once.

Any further information on this and other matters connected with children may be obtained by communicating personally with the Maternal and Child Welfare Information Bureau, 184 St. Paul's Terrace, Brisbane, or by addressing letters ''Baby Clinic,'' Brisbane. These letters need not be stamped.

ASTRONOMICAL DATA FOR QUEENSLAND.

JULY.

Supplied by W. J. NEWELL, Hon. Secretary of the Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			MINUTES LATER THAN BRISBANE AT OTHER PLACES.					
Day.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	6·39	5·03	Cairns ..	9	49	Longreach	27	43
6	6·39	5·05	Charleville ..	25	29	Quilpie	37	33
11	6·39	5·07	Cloncurry	37	63	Rockhampton ..	1	19
16	6·38	5·10	Cunnamulla ..	32	27	Roma	15	19
21	6·36	5·12	Dirranbandi ..	22	16	Townsville ..	8	41
26	6·34	5·15	Emerald	12	28	Winton	29	51
31	6·31	5·17	Hughenden ..	21	49	Warwick	5	4

TIMES OF MOONRISE AND MOONSET.

At Brisbane.

Day.	Rise.	Set.
	a.m.	p.m.
1	3·55	2·20
2	4·51	3·05
3	5·45	3·55
4	6·35	4·48
5	7·21	5·44
6	8·02	6·41
7	8·38	7·38
8	9·11	8·33
9	9·41	9·28
10	10·10	10·24
11	10·39	11·21
12	11·10	..
		a.m.
13	11·45	12·21
	p.m.	
14	12·24	1·25
15	1·11	2·33
16	2·07	3·44
17	3·13	4·53
18	4·24	5·57
19	5·38	6·54
20	6·49	7·42
21	7·56	8·23
22	8·59	8·58
23	9·59	9·30
24	10·57	10·01
25	11·55	10·32
26	..	11·04
	a.m.	
27	12·52	11·39
		p.m.
28	1·49	12·18
29	2·45	1·02
30	3·40	1·50
31	4·32	2·42

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

Charleville 27; Cunnamulla 29; Dirranbandi 19; Quilpie 35; Roma 17; Warwick 4.

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Day.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	10	30	26	44	0	20	28	53
6	11	28	26	43	1	19	29	51
11	20	17	36	32	11	8	42	37
16	30	9	46	24	21	0	54	26
21	23	14	39	29	14	4	45	33
26	12	25	27	41	2	17	30	49
31	9	30	25	45	0	21	26	54

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	6	53	35	66	20	51	6	44
3	2	56	33	67	17	53	3	46
5	5	52	35	65	19	50	5	44
7	12	44	38	60	23	46	11	37
9	21	34	44	54	29	39	18	29
11	32	24	52	46	36	31	26	21
13	43	17	59	42	44	27	36	16
15	53	7	67	35	50	21	44	8
17	56	2	68	32	52	17	46	3
19	50	6	64	34	48	20	41	7
21	39	16	56	41	41	26	33	15
23	27	28	48	49	33	34	22	24
25	16	39	41	57	26	42	14	34
27	11	50	38	63	23	49	10	42
29	3	55	34	67	18	52	4	45
31	2	56	33	67	17	53	3	46

Phases of the Moon.—New Moon, 4th July, 5.48 p.m.; First Quarter, 12th July, 2.56 p.m.; Full Moon, 19th July, 5.17 a.m.; Last Quarter, 26th July, 4.59 a.m.

On July 15th the sun will rise and set about 25 degrees north of true east and true west respectively and on the 4th the distance of the sun from the earth will be its greatest (94,600,000 miles). On the 10th and 23rd the Moon will rise and set approximately at true east and true west respectively.

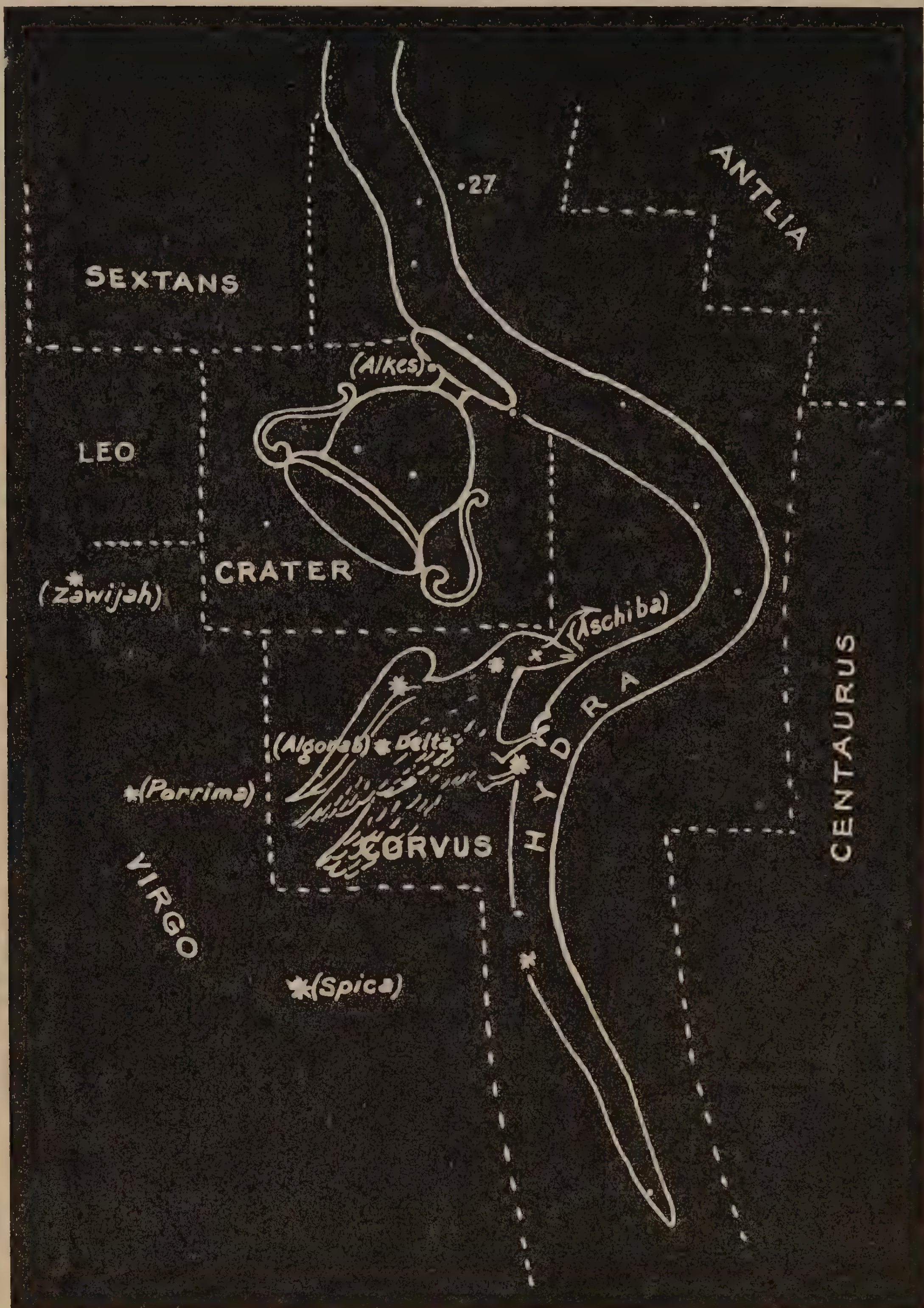
Mercury.—An evening object all this month. On the 1st, in the constellation of Gemini, will set 26 minutes after the sun. After passing through the constellation of Cancer, about the 27th it will pass close to Regulus in the constellation of Leo. By the 31st it will set about 2 hours after sunset.

Venus.—A most conspicuous object in the western evening sky, setting about 3½ hours after the sun at the beginning of the month and 3 hours after sunset at the end of the month. On the 7th it will pass close to Regulus, and on the 8th the four-day-old moon will pass very close; from Europe, Russia, China and Japan the moon will actually pass in front of Venus. It will reach greatest brilliancy on the 29th and towards the end of the month will be situated between Mercury and Saturn, Mercury being nearest to the horizon.

Mars.—Too close in line with the sun for observation at the beginning of the month but towards the end of July may be seen low in the east during morning twilight in the constellation of Gemini.

Jupiter.—A brilliant object, in the constellation of Pisces, rising soon after midnight at the beginning of July and between 10.15 p.m. and 11.30 p.m. at the end of the month.

Saturn.—Now seen in the west during evening twilight in the constellation of Virgo. On the 1st will set about 1 hour before midnight and on the 31st between 9 p.m. and 10.30 p.m.



THE CONSTELLATIONS.

Between Virgo (described last month) and Centaurus (described in the September, 1950, journal) lie the constellations of Corvus, the Crow, and Hydra, the Water Snake.

Corvus lies directly north of the Southern Cross, the long axis indicating the direction; and in the middle of July the group will be found in the western sky during early evening. It too shows up somewhat as a "cross" or as an irregular trapezium of 4 stars of second or third magnitude. Delta Corvi, nearest Spica, is a double star, one star being of 3rd magnitude and the other 8.5 magnitude; they are separated by 24 seconds of arc.

Hydra is a long, narrow, straggling constellation starting near the constellation of Cancer and Canis Minor and stretching generally in an E.S.E. direction to pass Corvus and end between the constellations of Virgo and Centaurus. It covers almost 100 degrees of the sky in an east and west direction. The constellation is so long that some part of it is on the Meridian at 8 p.m. from the end of March to the beginning of July.

27 Hydra is a planetary nebula. This particular type of nebulae is more or less circular in form. They are called planetary because in a small telescope they resemble the disc of a planet. Only a few have a bright central condensation but all have a central star of small mass and high temperature to which the visibility of the nebula is due.

To the west of Corvus is Crater, the cup, a rather inconspicuous group which has no object of interest to the amateur observer.

Supplement to the "Queensland Agricultural Journal," March, 1952.

Volume 73

QUEENSLAND AGRICULTURAL JOURNAL

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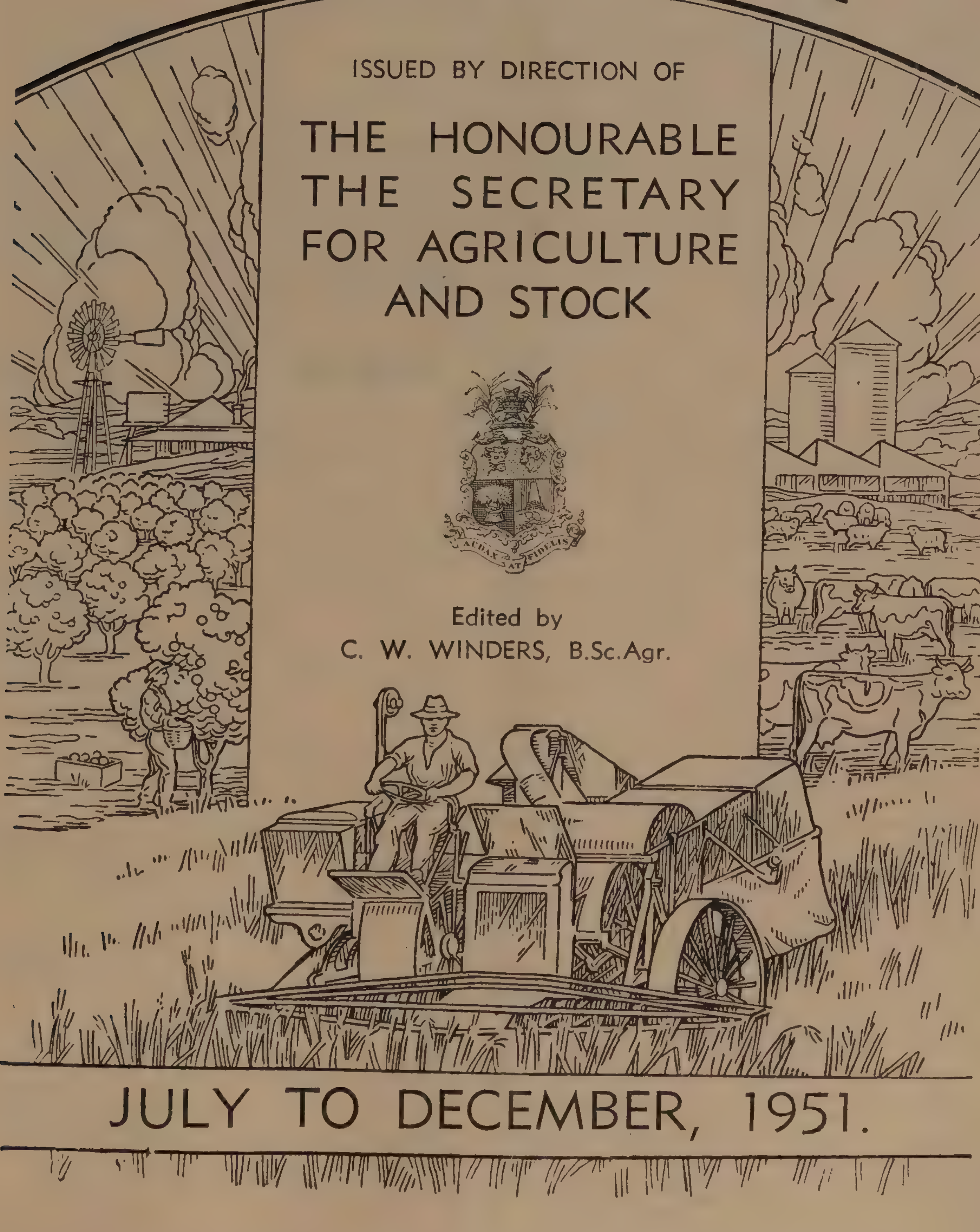

Edited by
C. W. WINDERS, B.Sc.Agr.

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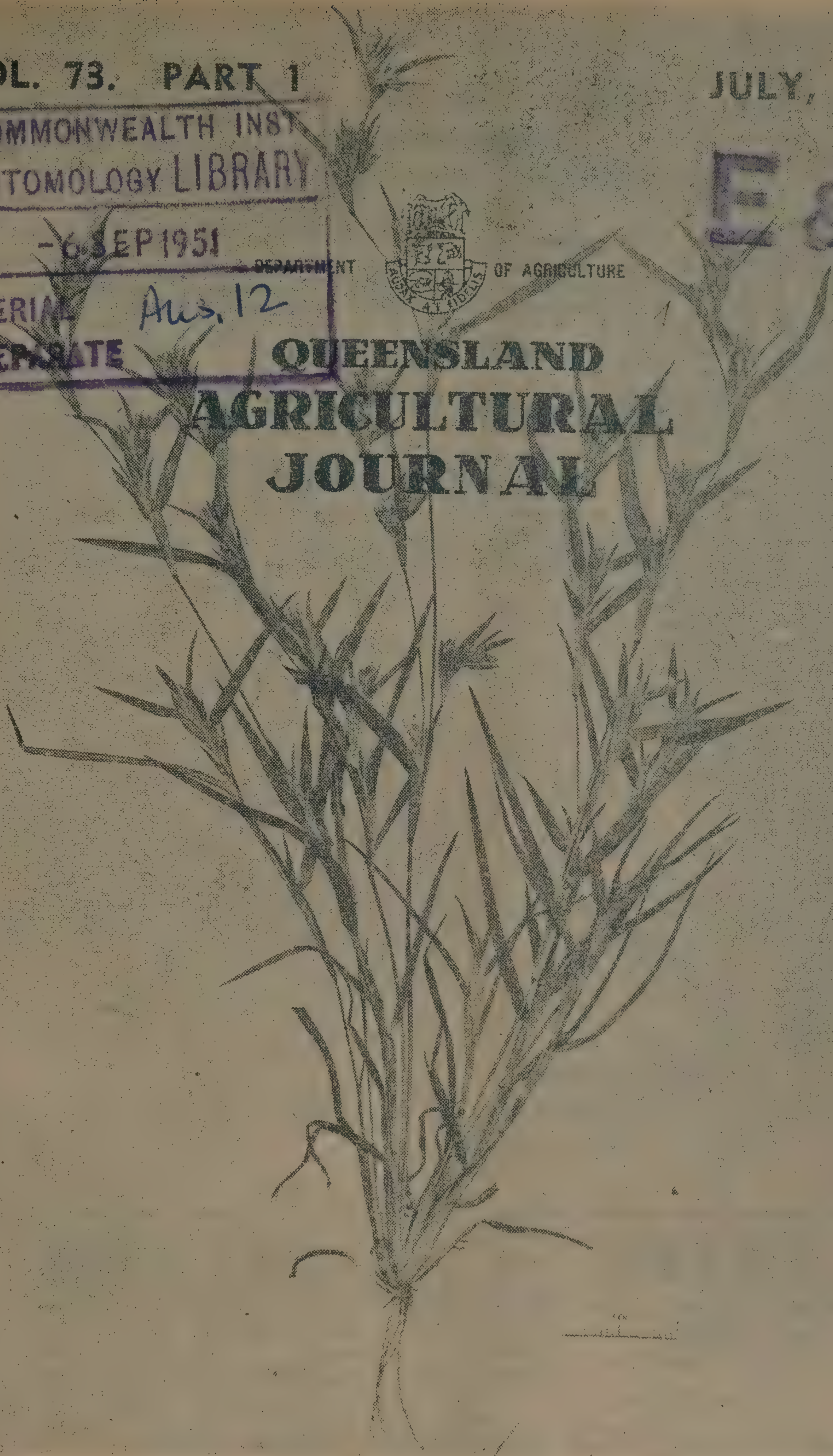

Flinders Grass—A Valuable Plant in Native Pastures.

LEADING FEATURES

Soil Conservation in Orchards
Horticulture in Central Queensland
Cleaning Dairy Equipment
Green Panic Grass
Sweet Potato Weevil
Springbrook Pasture Trials
Sheep Blowfly Control

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Contents

Soil Conservation in Queensland.

8. Soil Conservation in Horticultural Areas.

J. E. LADEWIG, Senior Soil Conservationist, and A. F. SKINNER, Soil Conservationist.

ALTHOUGH the total area of land utilised for the production of horticultural crops in Queensland represents only a small percentage of the available arable land in the State, it nevertheless supports a high population density and is of considerable economic importance.

At present the chief centres of fruit and vegetable production in Queensland are located along the coastal fringe and in the Granite Belt. A large proportion of the land devoted to the production of these crops, particularly bananas, papaws and pineapples, is of very rugged topography, and this, when combined with high-intensity rainfall conditions, creates a serious erosion danger. As a result of the insidious process of sheet erosion, noticeable losses of topsoil have already occurred on large areas of this land, and on the steeper slopes of the coastal ranges there have been mass movements of land in the form of slips and creeps.

The present rate of decline in productivity of much of our horticultural land, due to erosion, is such that the adoption of measures for its prevention are an urgent necessity. Where it cannot be prevented entirely, steps should be taken to extend the life of the land to the maximum extent possible.

Many horticultural crops are perennials and therefore opportunities exist for the protection of the soil by such means as cover cropping and stubble mulching. Since the area devoted to horticultural crops on a farm is usually small, the planning and implementation of complete soil conservation programmes is accordingly much easier and cheaper than for larger agricultural holdings.

In the past, clean dust mulch cultivation was the rule rather than the exception and was based on the erroneous belief that the loss of soil moisture by evaporation was reduced by this type of cultivation. In actual fact the exposure of bare and finely tilled soil provided perfect conditions for erosion. Fortunately most orchardists now know that a protected soil will not erode, and cover cropping is being practised to a greater extent than formerly.

Plate 1.
A North Coast Banana Plantation Where Contour Planting, Cover Cropping and Mulching Procedures are Practised.

Plate 2.
Erosion in a Papaw Orchard Where Square Planting has been Practised.

Where there is a risk that cover crops will result in undue competition for soil moisture, stubble mulch procedures may be adopted either partly or wholly. Some orchardists have, with success, adopted the practice of growing Sudan grass or a similar crop in an area adjoining the orchard and, when mature, mowing the crop and transferring it to the orchard area to form a mulch up to six inches deep. This mulch is sufficient to suppress weed growth and reduce evaporation, and it certainly prevents erosion.

Where competition from cover crops is likely to affect a crop, it is sound practice to mow or lightly disc the cover crop and leave it on the ground surface as stubble mulch in order to reduce the erosion hazard.

SOIL CONSERVATION IN ORCHARDS AND VINEYARDS.

The prevention of erosion in new orchards or vineyards presents few problems if the landowner plants the trees on the contour and is prepared to adopt cover cropping and stubble mulching procedures designed to protect the soil and ensure maintenance of soil structure and fertility.

The orchardist accustomed to square planting systems may at first be confused by the apparent complication of contour layouts; the necessity of surveying of planting lines, provision of water disposal outlets and construction of contour banks may appear to be an unnecessary addition to the establishment programme. However, experience will show that this type of layout is easily applied, that cultural operations are simplified and that the benefits conferred through the conservation of soil and water far outweigh any apparent disadvantages.

Contouring.

The planting of orchards on contour lines is a most important requirement for the application of soil conservation practices to these lands. Contour planting means planting on a level or true contour line, or, as is more usual, planting along a line with a slight fall which is sufficient to enable surplus runoff to move across the field without scouring or carrying soil. This gradient normally should not exceed 6 inches per 100 feet but in special circumstances may be increased to 2 feet per 100 feet.

When contouring is practised, all cultivation operations are carried out on the contour or level. This ensures the pondage and absorption of a maximum amount of rainfall, and runoff and erosion are reduced to a minimum. This is in contrast to the square system of planting where up and down slope cultivation, on at least some sections of the area, is unavoidable; under these conditions runoff water finds a ready outlet, the velocity of the water increases rapidly because there is nothing to impede its downslope movement, and soil is carried away.

Where the land slope is comparatively gentle or the soils have a high absorptive capacity, and rainfall is not excessively heavy, erosion can be prevented by the adoption of contour planting and the associated contour cultivation, provided cover cropping and stubble mulching is practised to the maximum extent. However, in many of the horticultural areas of the State these conditions do not apply and it is necessary to provide additional protection by the construction of water diversion structures such as contour banks.

Plate 3.

A Citrus Orchard Planted on the Contour. The cover of vegetation protects the soil from the intense summer rains. Each row of trees is planted on a contour bank.

Since contour banks permit the diversion of runoff water to the disposal site, it is most important that prior provision be made for the safe disposal of water before the construction of banks is commenced. Where well grassed areas adjoin the orchard, the water from contour banks can be spread on grass, to the benefit of the pasture and without danger of causing erosion. In intensively settled areas, such disposal sites are not always available; in these cases the construction of a waterway and the establishment of vegetation thereon is a necessary pre-requisite to the construction of contour banks. Methods of constructing and vegetating these waterways were described in an earlier part of this series of articles.

Contouring the Orchard.

The method of contouring a new orchard will vary according to the topography of the land. In an area with regular slopes it is simply a matter of surveying, at the upper edge of the field, a contour line with the appropriate gradient to carry water to the outlet point. At intervals of 100 to 150 feet down the slope (depending on soil type and degree of slope) further bank lines are surveyed on the same gradient. Contour banks are constructed on these lines, which then serve as ''key'' lines, and tree rows are established in relation to them.

The bank spacing recommended above applies only to areas of moderate slopes; further, the success of banks spaced at this width is dependent upon a system of inter-row drainage, which can be assured by opening a substantial furrow between each contour row of trees.

On slopes exceeding 8 per cent. this protection is inadequate and it is then preferable to construct a series of banks corresponding to each tree row. Since they are closely spaced, these banks are usually smaller than for lesser slopes. Mechanical soil drift which is inevitable on steep slopes gradually builds up against these banks and eventually a bench terrace is formed.

Fields which can be designed as simply as described above are a rarity in the State, and where there is any marked variation in land conformation, irregularity will occur in width between banks; to achieve the best layout in cases such as this it is necessary to first prepare a contour map of the area. Variations in width of contours are clearly shown on such a plan, enabling the development of the most effective layout and the most efficient utilisation of the land prior to commencement of work in the field.

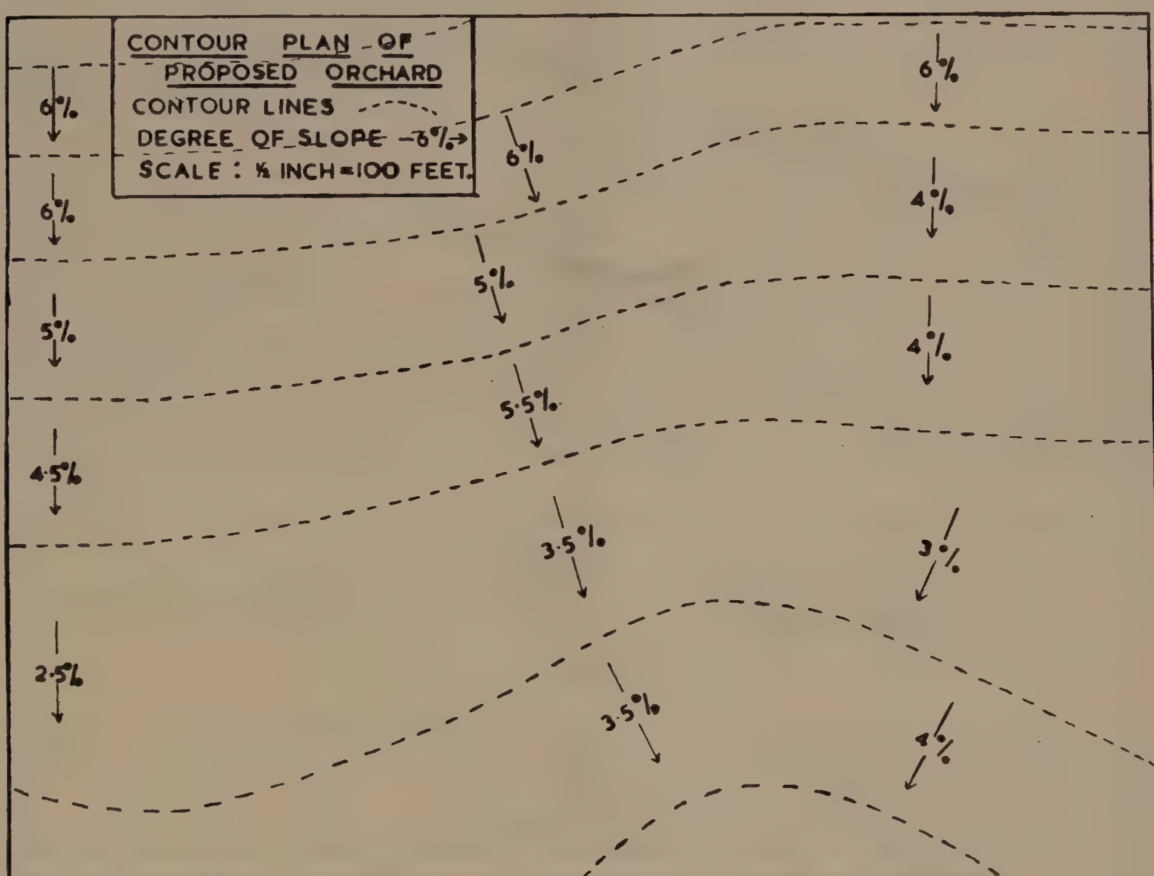


Plate 4.

Contour Plan of a Proposed Orchard.

Plate 4 shows a contour plan of a proposed orchard and Plate 5 illustrates the final layout.

The advance preparation of a contour plan is a good investment and can be done most easily by first pegging a 50-foot grid over the entire paddock. Levels are taken at each peg and a contour plan is prepared from this data. This plan is necessary for the careful and accurate designing of contouring systems, including the location of waterways, access tracks and fences. Contour bank lines and tree rows are plotted tentatively on the plan, various layouts being tried experimentally and finally the most satisfactory one chosen. This plan is taken into the field and appropriate distances (as determined from the plan) measured from the various grid pegs to establish the lines for

the contour banks and tree rows. Since minor errors may occur it is desirable to check the accuracy of bank lines to ensure that correct gradients are allowed within the tolerance of 2 inches per 100 ft. to 2 feet per 100 feet.

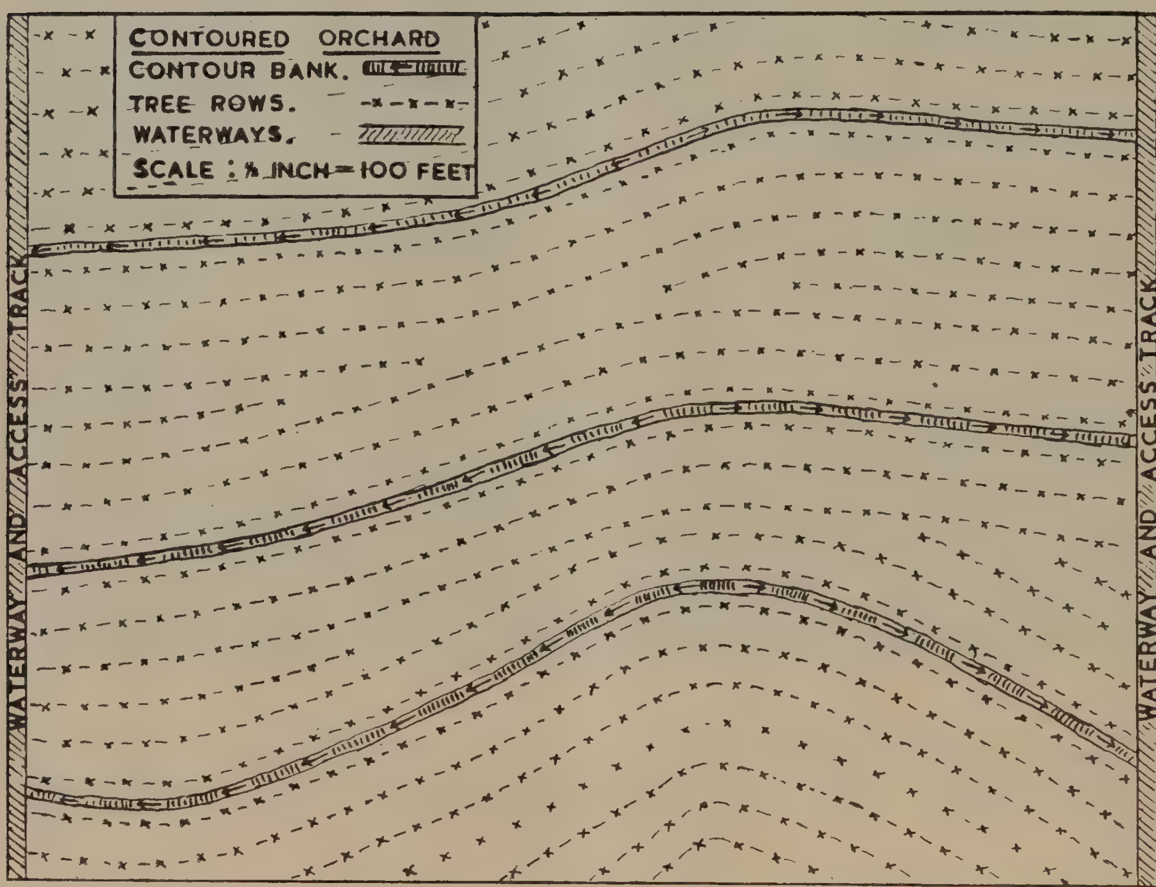


Plate 5.

Conservation Plan for the Orchard shown in Plate 4.

Where a surveying service is not available, it is practicable for a landowner to carry out a reasonably accurate grid survey utilising improvised equipment. One of the many types of improvised levels may be used; these include simple builders' levels, a spirit level attached to a tripod, a water tube level, or even a long length of hose filled with water.

Planting Trees on the Contour.

Having established "key" lines by the construction of contour banks, two alternatives are available for the planting of the trees in relation to the contour banks. A tree row may be established along the crest of the bank, or alternatively one row may be planted above and parallel to the channel and the other row immediately below the bank. The latter system was the one used most in early soil conservation work but there has been a trend in recent years towards the planting of a row along the crest of the bank. This provides a very satisfactory site for establishment purposes but bank maintenance is made more difficult in later years because of the tree canopy. The soil moved in bank maintenance may also result in the burial of the stock-scion union with possible detrimental effects in the case of citrus, custard apples and avocadoes.

Once the "key" planting lines are established the remainder of the orchard may be planted in one of two ways:—

(1) The second line is established at the appropriate spacing below the key line and parallel to it; each row is then spaced downslope from this until part or all of a row closes to within the determined spacing distance from the key planting line of the bank below. Where the interbank spacing is irregular in width it may be necessary to plant one or more short rows to fill in the widest part.

(2) The second row is established as above but the following row is run parallel to the key planting line of the bank below. Planting lines are then run parallel to both upper and lower lines until part or all of a row closes to within the predetermined row spacing distance. Short rows, if necessary, are then planted, but in this case they are located in a centre position between two banks whereas in the first method they are immediately above the lower bank.

Contouring an Established Orchard.

The contour planting of trees is obviously not applicable in established orchards, but it is still practicable to take steps to reduce the erosion incidence.

Waterways are planned, constructed and vegetated as in the case of new orchards and provision is made to intercept runoff by means of contour banks. The spacing, position and gradient of these banks is determined so that they will cause the minimum of dislocation. It is necessary to remove some trees, but this can be minimised by careful

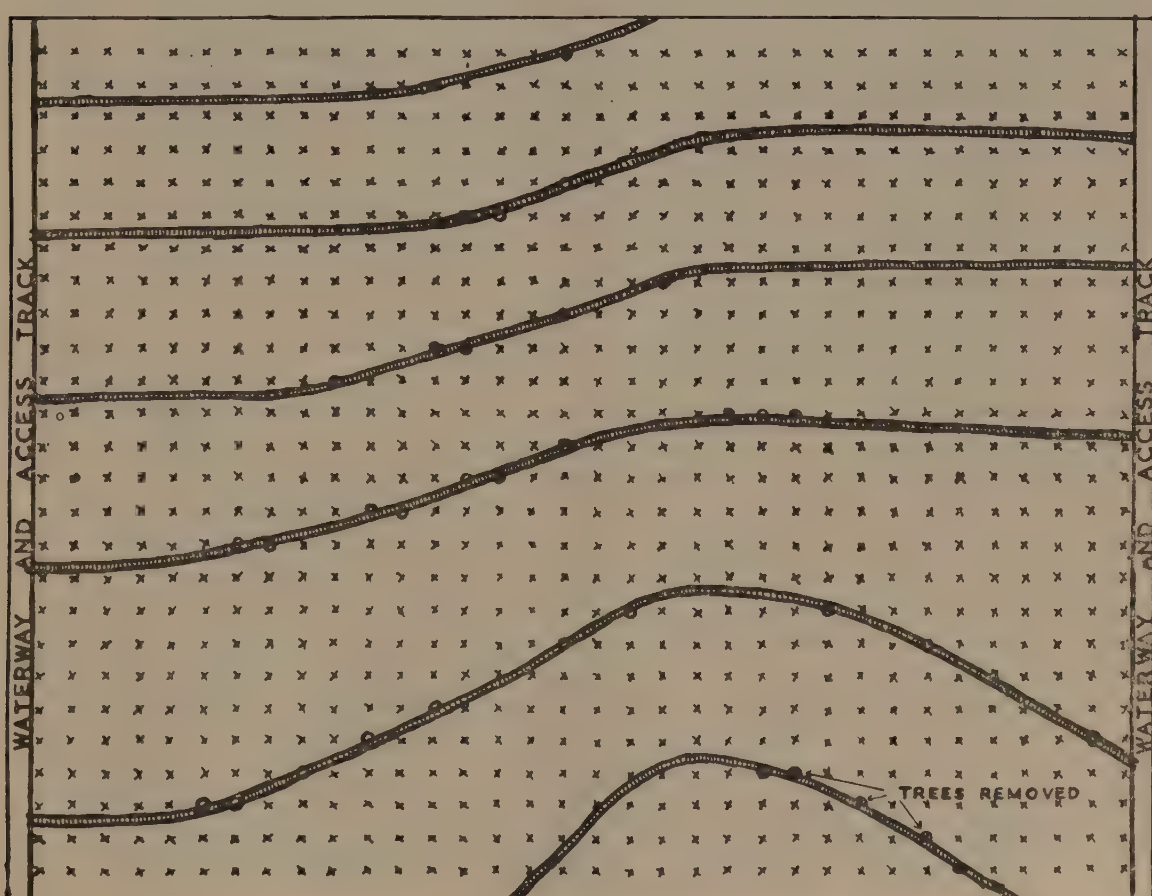


Plate 6.

Contour Plan for an Established Orchard.

selection of gradients and spacing of banks within the permitted tolerance. On average slopes the distance between banks may vary from 60 feet to 120 feet, and bank gradients within the tolerance of 2 inches per 100 feet to 2 feet per 100 feet.

Because of the necessity to avoid damage to trees, a narrow type of bank is constructed with a relatively deep narrow channel above.

Plate 6 illustrates the application of contouring principles to an established orchard. The topography of the land is the same as in Plates 4 and 5, but it will be noted that additional banks are required as illustrated in Plate 6 because contour cultivation cannot be practised to the same extent. The trees which have to be removed to accommodate the contour banks are indicated by a circle; in this particular case it is necessary to remove only 5 per cent. of the trees.

SOIL CONSERVATION IN BANANA PLANTATIONS.

Most of Queensland's banana land is located on the very steep slopes of the coastal ranges in the south-east.

The practice has been to clear the scrub of forest and, following the burn, to plant the bananas between the remaining stumps and logs. The slopes utilised are rarely less than 30 per cent. and frequently exceed 50 per cent. The areas are consequently completely unstable when the protective scrub cover has been removed. These areas are subject to sheet erosion rather than gullying but the most serious problem on the steeper slopes is that of landslides.

The utilisation of these steep slopes for what is virtually clean cultivation is completely contrary to principles of correct land utilisation; no conservation action, with the possible exception of bench terracing, can avert the eventual abandonment of these lands.

Plate 7.

A Banana Plantation Planted on the Contour, Showing a Contour Interception Drain.

Their life may be extended by the adoption of cover cropping to the maximum extent, utilising leguminous crops wherever possible. It is quite practicable to adopt a system of contour planting similar to that described for orchards; instead of contour banks, however, it is necessary on steep slopes to open a narrow deep contour drain in approximately every second row. The soil from the trench is disposed on the upper side and suitable grass filter strips established in the mound of soil. Soil moving down the slope is trapped against the mound and in the filter strip, eventually leading to the development of a modified type of bench terrace.

Logging of the slope on the contour, the disposal of discarded banana plants on the contour, and the maximum use of crop residues for the protection of the soil surface, all assist in reducing the incidence of sheet erosion.

Landslides or slip erosion will still occur despite the measures listed, and it is this type of erosion which ultimately has the most serious effect on the productivity of these banana lands.

There is no known control for this type of erosion, but these areas may be profitably utilised for forestry purposes because the deep penetration of tree roots tends to anchor the soil mass in place. Slips will still occur occasionally even under forest cover, but the incidence will be considerably reduced.

Plate 8.

Pineapples Planted on a Bench Terrace.

SOIL CONSERVATION IN PINEAPPLE AREAS.

The specialised requirements of this crop in respect of both soil moisture and temperature make it most difficult to design complete soil conservation measures.

Because of its sensitivity to low temperatures, this crop is normally grown on the sloping lands of the south-eastern coastal fringe; the slopes in use commonly exceed 20 per cent. and occasionally exceed 50 per cent. Slopes such as these are unstable under clean cultivation conditions and *permanent* conservation of soil cannot be effected without resort to practices such as bench terracing. Although these lands are normally cleared of stumps and timber, bench terracing is scarcely a practicable procedure at this stage because of the cultural disabilities involved.

The success of the bench terrace in countries such as China and the Philippines over a period of hundreds of years is evidence of the stability of this type of structure when supported by correct horticultural practices. Bench terracing is more suitable under conditions where labour is cheap and the major part of the cultural operations is executed manually. Since a major alteration of cultural methods is necessary to enable the utilisation of bench terracing for Queensland conditions, it is preferable at this stage to consider other less permanent methods of control which will result in a lesser dislocation of cultural practices.

Two main methods of control may be utilised:—

(1) Contouring.

(2) Cross-sectional drains.

Contouring.

This method of control is still in the developmental stages in this State, but where it has been applied it has effected a very satisfactory degree of control. On the shallow soils there is a possibility that the increased penetration of moisture resulting from contouring practices may produce conditions not entirely favourable for pineapple growth. However, unsatisfactory growth is usually associated with these soils even with up and down slope planting and it is probable that the utilisation of subsurface drainage systems will be necessary for satisfactory pineapple production on these soils.

Of the range of contouring practices which may be utilised, probably the most satisfactory for Queensland conditions involves the construction of a modified type of contour bank. Because of the steep slopes it is necessary to construct a comparatively narrow bank with a deeper and narrower channel than is normally used on the more gentle slopes.

On steep slopes erosion will occur from the downslope movement of water over comparatively short distances and consequently the construction of contour banks alone, even at the closest practicable spacing, will not prevent major soil movement. It is therefore necessary to intercept the runoff at each row and transfer it along the inter-row space to the outlet or waterway. Under these conditions the maximum downslope movement of water does not normally exceed six feet, and a comparatively small inter-row furrow is sufficient to ensure the safe flow of this quantity of runoff.

Plate 9.
Type of Contour Bank Suitable for Use on Steep Slopes.

Plate 10.
Pineapples Planted on the Contour With Interception Furrows Between Each Double Row.

Since the runoff is intercepted in smaller quantities it is also practicable to increase the fall of gradient of the rows without causing scouring. This point is of considerable importance in designing structures necessary to reduce erosion to a minimum but at the same time prevent oversaturation of the soil.

Plate 11 illustrates a typical contour layout applied to a 25 per cent. slope.

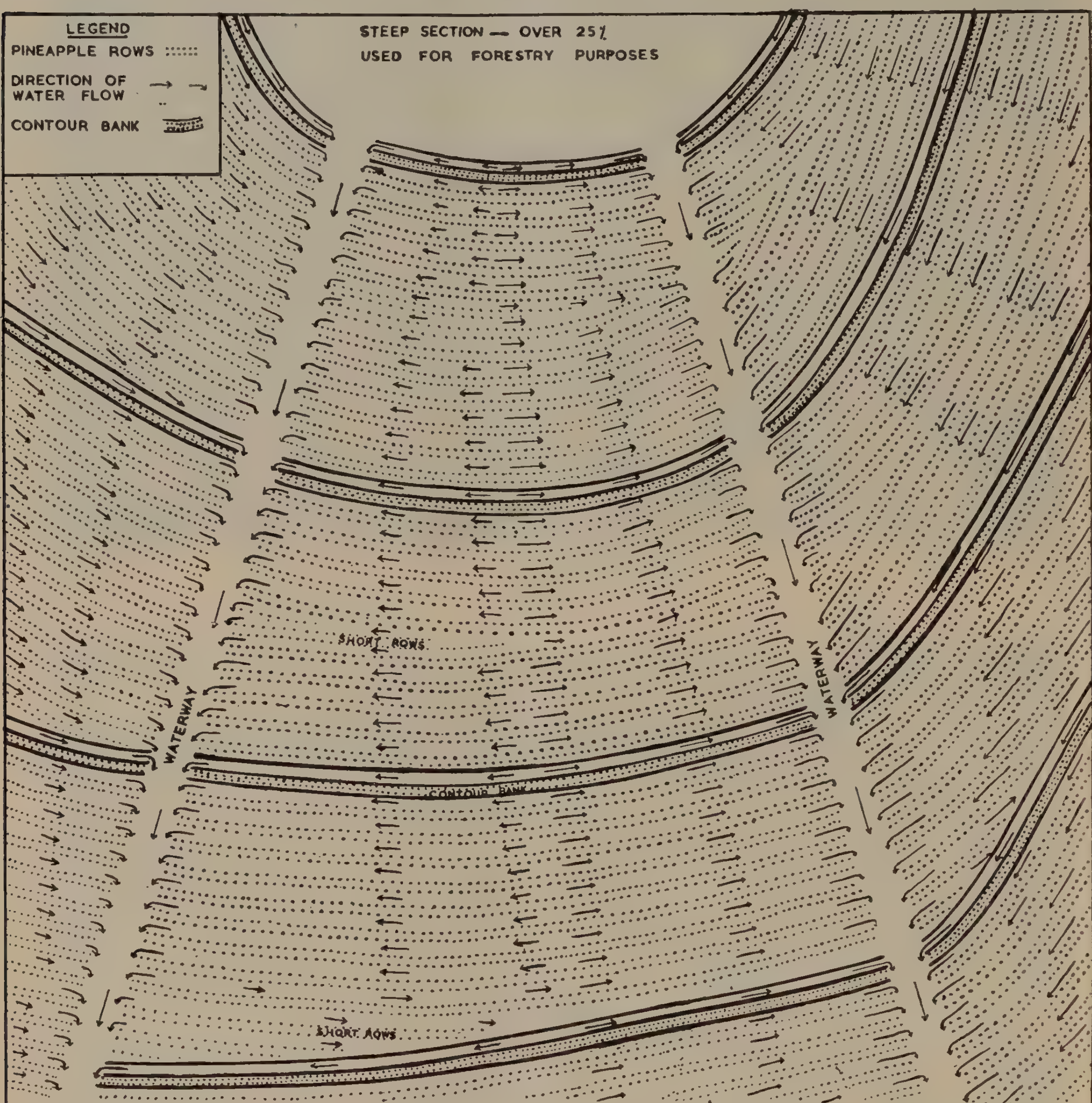


Plate 11.

A Contour Layout for Pineapples on a 25 per cent. Slope.

The method of bank construction will vary according to the type of equipment available for the work; where a suitable type of grader ditcher is available a comparatively large bank is constructed with a water carrying cross-section of approximately 4 square feet. In this case a bank spacing of approximately 70 feet may be adopted. Where grader equipment is not available a smaller bank may be constructed by the utilisation of a single furrow mouldboard plough for opening up and loosening the soil; excavation is done with a shovel and the soil deposited to form a bank below the furrow. The cross-sectional capacity of these banks rarely exceeds 2 square feet, and consequently a much closer spacing is required; the normal spacing in this case is approximately 35 feet.

Plate 12.

The Section Shown in Plate 9 After the Pineapples Have Been Planted.

Application of Contouring Practices.

The provision of a stable water disposal system is a very necessary pre-requisite; in the interests of safety of control works and efficiency of harvesting it is desirable to limit the length of banks to a maximum of three to four chains and the position of waterways is determined in accordance with this factor. A combined waterway and access track spaced at this distance enables efficient water disposal at both ends of the bank and fruit has not to be carried more than $1\frac{1}{2}$ to 2 chains to a roadway during harvesting.

Where waterways are also to be utilised as roadways, care in design and establishment is most necessary to prevent the development of gullies at a later stage. The waterways are constructed about 12 feet wide, with both edges level, but with a pronounced dish towards the centre; the bottom of the waterway should be at least 9 inches below the surrounding land to assist drainage from the contour rows. Kikuyu or buffalo grass sod is established over the entire waterway, and when the grass cover is complete, water from contour rows and banks may be carried without danger of scouring. Wheel vehicles are utilised for harvesting and transport and since the wheels straddle the main water-carrying section the danger of erosion along wheel tracks is minimised. This type of design is not suitable where slides are used for transport because of their destructive effect on vegetation, and in this case it is necessary to provide a roadway intermediate between two waterways, and bank gradients are designed to transfer all runoff from the roadway towards the waterways. In this case the waterway width may be reduced to eight feet for drainage areas not exceeding two acres.

Plate 13.

A Combined Waterway and Access Track.

Planting on the Contour.

Because of the curving rows involved in contour planting it is not practicable to use a planting line as for the normal square planting systems. However, since contour banks are constructed in advance of the planting programme they provide convenient base lines which will ensure the correct gradient of the pineapple rows.

The pineapple rows may be planted parallel to the bank above, and where there is a variation in the width of the bank interspace short rows will end at the contour channel. An alternative system is to plant parallel to the upper and lower banks, with short rows finishing in the centre of the bank interspace.

Cross-Sectional Drains.

This method of control was developed many years ago and where it has been applied carefully and systematically has resulted in a considerable reduction in the erosion incidence. A very serious disadvantage associated with this type of control is the continued loss of soil by sheet erosion because the pineapples are planted in straight rows which usually run up and down slope, though occasionally they are planted parallel to or at a slight angle to the drains.

The design is simple and involves the excavation of a number of shallow drains on a herringbone pattern; these drains are spaced approximately 40 feet apart and parallel to each other and drain towards a main disposal channel. The drains are often designed on an excessive gradient to prevent siltation and consequently result in greater soil losses than would normally occur under contoured systems of control.

Plate 14.

Showing the Location of Short Rows in a Centre Position Between Two Contour Banks.

Cross-sectional drains are suitable for use on shallow poorly drained soils, but it is essential to minimise soil loss by the systematic adoption of mulching procedures.

Mulching.

Earlier discussions have indicated the value of protecting the soil surface and in pineapples this can be achieved most effectively by utilising sawdust, crop residues or grass to provide a protective surface mulch. If this protection is systematically applied, the soil pounding and raindrop splash effects are eliminated and soil movement minimised. The increased infiltration rate ensures a maximum absorption of rainfall and water diversion structures such as contour banks and waterways are able to more effectively protect the land during periods of excessive rainfall.

The introduction of new weedicides in recent years has facilitated the control of many weeds, and the application of mulch may now be made without the former disadvantage of interference with chipping operations.

SOIL CONSERVATION IN VEGETABLE GROWING DISTRICTS.

The control and diversion of runoff presents only minor problems in vegetable growing districts because the area of the farms usually does not exceed a few acres. There are, however, many secondary problems involved in the design of measures which will prevent erosion and at the same time result in a minimum of dislocation of current horticultural practices.

The fixed spray-line irrigation system is the one most commonly used for vegetable production, but this system has only a limited degree of flexibility and the maximum irrigation range normally does not exceed a line 16 to 20 feet from and parallel to the position of the spray lines. Since the spray lines can be installed along a contour bank line, for convenience in cultivation, it is most important in soil conservation design to ensure that contour banks are installed parallel to each other where practicable and also that the distance between banks conforms with the width effectively watered from each spray line. Where the irrigation coverage is 40 feet, contour banks are designed on either a 40 feet or 80 feet spacing.

Since most contour lines curve in accordance with land conformation a soil conservation design invariably requires some curves in the spray lines. This is minimised where practicable by the adjustment of bank gradients within the limits of 2 inches per 100 feet to 2 feet per 100 feet. Where ¾-inch spray line is utilised the bends do not present serious difficulties, but where larger piping is used the fitting of a semi-flexible coupling at bends is a necessary requirement.

Contouring.

Prior to the design of soil conservation measures it is necessary that a contour plan of the area be prepared. The base plan is prepared as described for orchards, and the position of waterways, access tracks, contour banks and spray lines is superimposed to form the complete conservation plan.

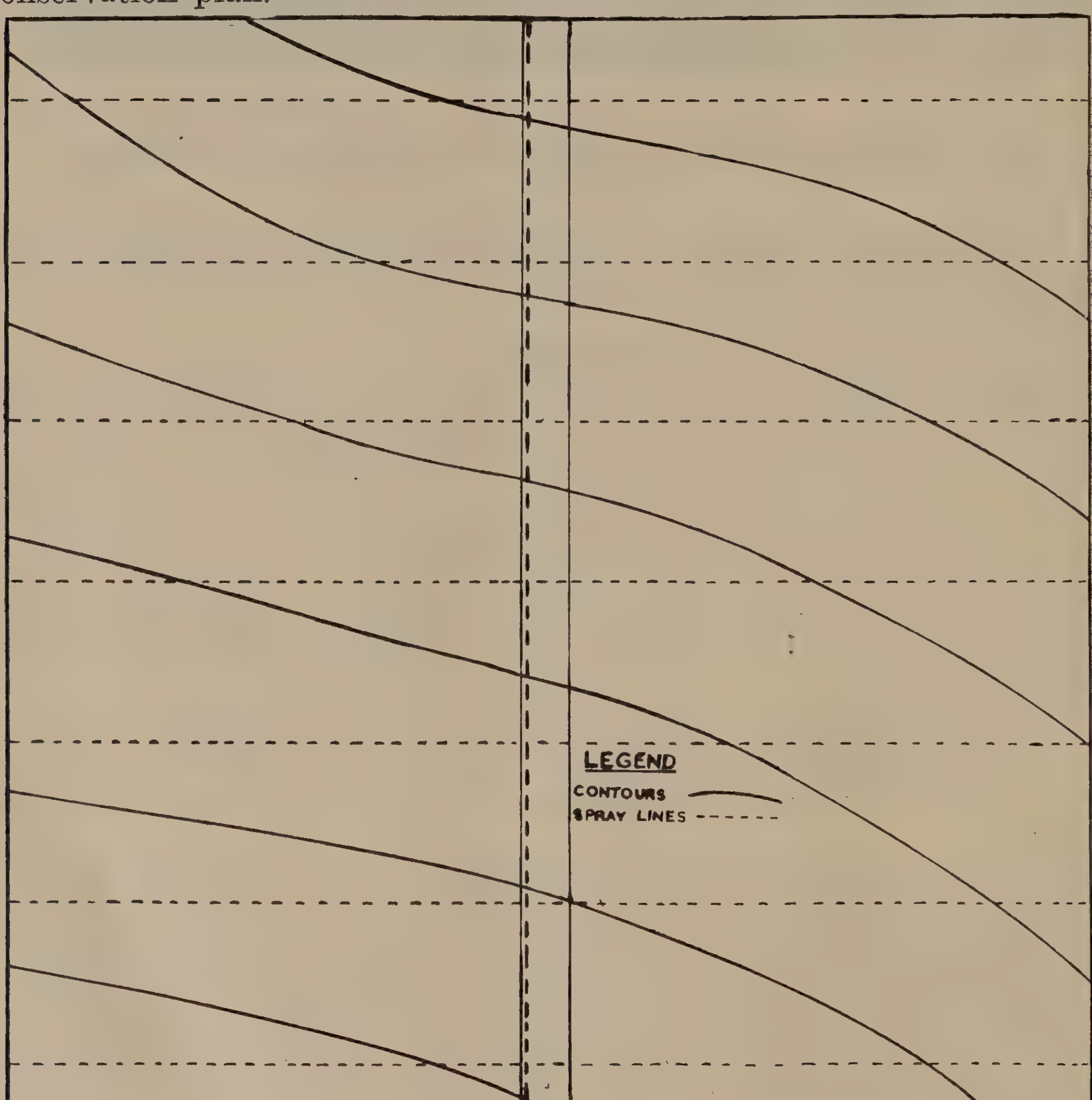


Plate 15.
Contour Plan of Vegetable Farm.

A number of trial designs are fitted to the contour plan until the most acceptable layout is determined.

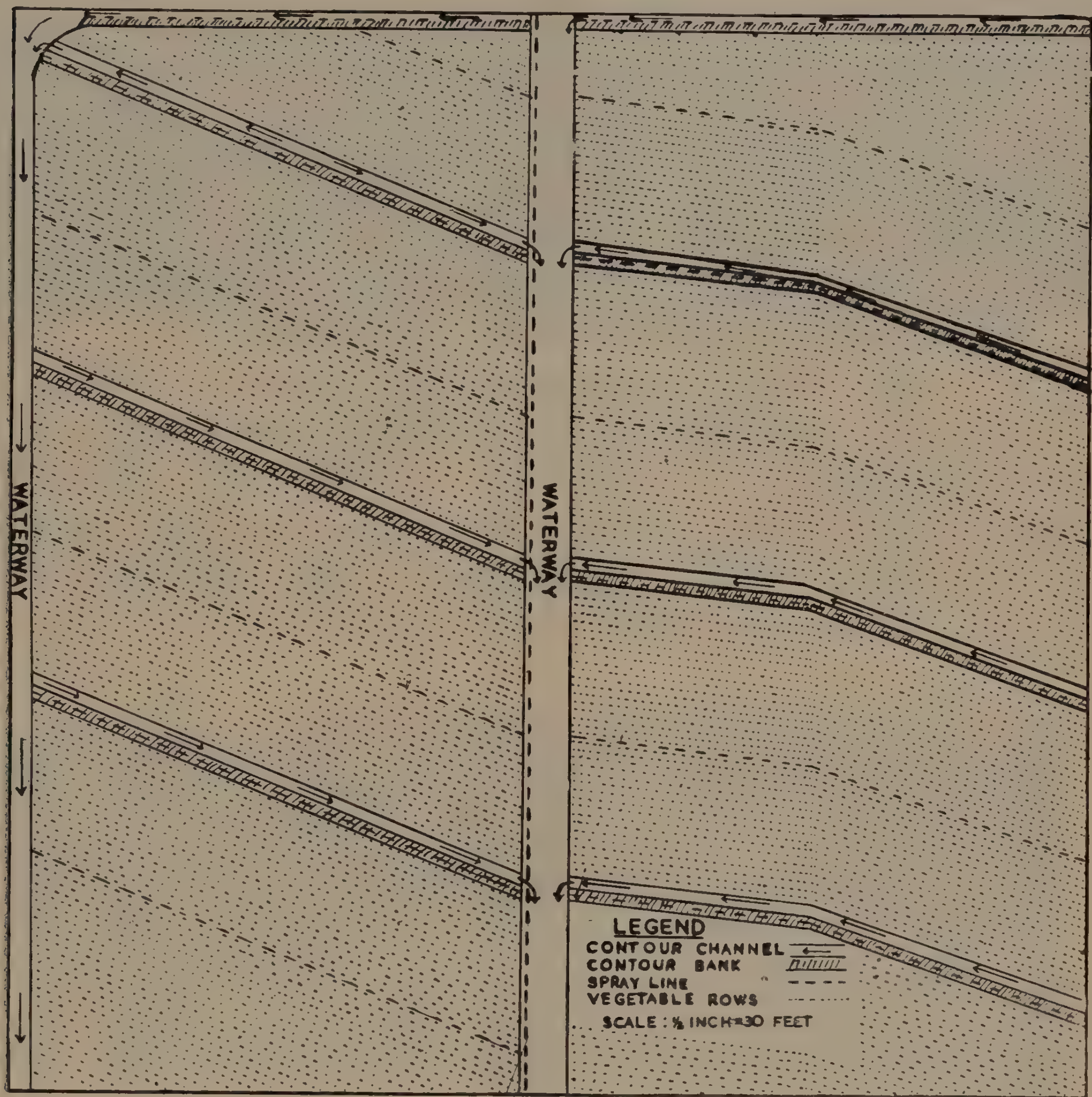


Plate 16.

A Contour Layout Applied to the Area Shown in Plate 15.

The provision of stable waterways is a necessary requirement; a concave waterway as described for pineapple areas is the most suitable and where practicable should be constructed so that the bottom of the waterway is nine inches below average ground level. Buffalo, couch and kikuyu grasses are the most suitable for these waterways but because of their vigorous growth habits they require careful management in small crop areas; for this reason Rhodes grass is preferred.

The type of contour bank constructed will depend on the bank spacing; where an 80 ft. spacing is used a broad-base bank is constructed with plough or small grader, but for a 40 ft. spacing a small, narrow bank is sufficient and is more suitable where the construction work is done mainly with the single-furrow plough and shovel.

The plant rows are established parallel to the contour banks and, where practicable, it is desirable that each row should carry a maximum amount of runoff towards the waterway. Bedding or hilling procedures will assist considerably in ponding the maximum amount of runoff between the rows and safely transferring the excess to the waterway.

Irrigation efficiency can be considerably improved on sloping lands where contouring is practised because of the better opportunity for infiltration.

Agronomic Practices.

The almost continuous clean cultivation involved in vegetable production, and the regular succession of crops on the one piece of land, tend to cause a rapid deterioration in soil structure. Since the infiltration rate also decreases under these conditions a most important requirement for the successful application of soil conservation measures is the adoption of practices which will lead to an improvement in soil structure and the capacity of the soil to absorb and retain moisture.

The primary requirements for these purposes are:—

(1) The retention of crop residues to the maximum extent.

(2) The adoption of regular cover-cropping and green manuring procedures in which leguminous crops and cereals are utilised.

(3) The adoption of crop rotations which will ensure that the land is "rested" under a cover of grass or a dense legume such as pigeon pea for a period of three years in ten.

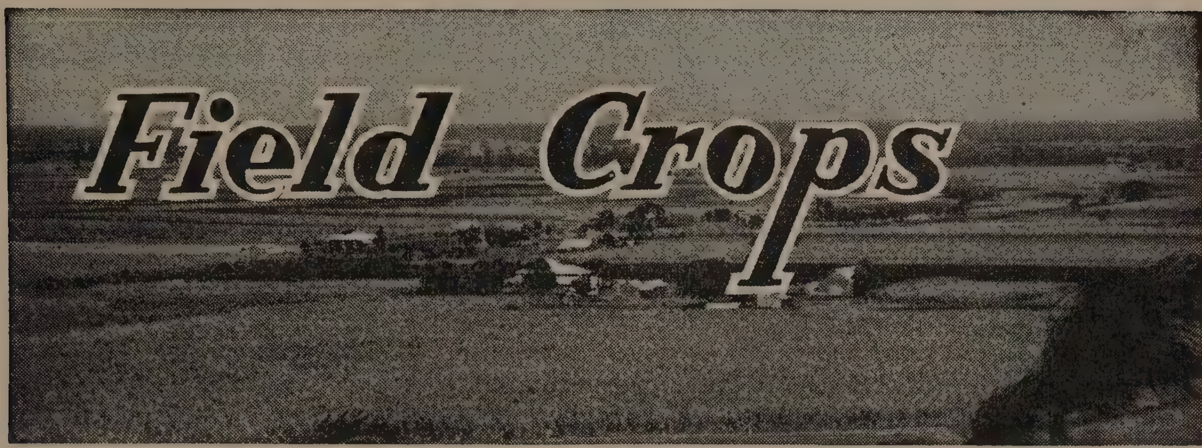
HORTICULTURAL EXPERIMENT STATION WORK.

Fruit and vegetable growers are invited by the Horticulture Branch of the Department to visit the experiment stations at Ormiston and Nambour to examine investigational work in progress at those stations.

The official visiting days are Fridays at the Redlands station at Ormiston, and Tuesdays at the Maroochy station near Nambour. On these days officers are available to conduct parties around the properties and to explain the work in progress. Where practicable, the manager should be advised by telephone or letter of contemplated visits.

The Redlands station is concerned primarily with plant nutrition and soil problems affecting the fruit and vegetable industries in the Redlands district. The Maroochy station deals mainly with the problems of fruit production on the North Coast, with particular attention at present being given to pineapples, papaws and bananas.

The planting of horticultural crops on the contour is a feature of the Maroochy station, and growers who have their plantations on sloping ground will find much of interest in the contour-planted bananas and pineapples on the station.



Green Panic Grass.

S. MARRIOTT, Agrostologist, and W. J. WINCHESTER, Senior Adviser in Agriculture.

GREEN panic grass (*Panicum maximum* var. *trichoglume*), also known in Queensland as fine stemmed Guinea and slender Guinea, is a variety of the common Guinea grass. As the name suggests, these grasses are natives of Africa, but they are now common in many tropical countries.

Plate 17.

Topping Off Herefords on Green Panic on "Madoora," Gayndah.—The paddock had been spelled for three months before grazing.

Green panic covers a considerable area in the Central Burnett, where its use on a commercial scale was pioneered by Mr. A. A. Petrie, of "Madoora," Gayndah, who over a period of some 15 years has established it on approximately 800 acres for grazing purposes. The

grass is also grown on the Atherton Tableland and adjacent country, while in trial plots which have been established in most of the State's dairying districts, it has in many cases shown distinct promise.

Description.

Like Guinea grass, green panic is a tall, tufted, summer-growing, perennial grass with an open type of seedhead, or panicle, which may be up to nine inches in length. Compared with common Guinea, green panic has a much finer stem and leaf, while its spikelets (''seeds'') are covered with fine hairs, this latter character being used for botanical identification. When ungrazed it may reach a height of five feet or more under favourable conditions.

There appear to be several forms of the variety, and in observation plots variations in rates of growth, particularly following mowing or grazing, have been noted. Some seem markedly superior to the commercial standard variety in this respect but no seed of these new strains is yet available for general use.

Climatic Requirements.

Green panic makes its main growth during the summer. Severe frosts will check development and wither the upper foliage, but fresh growth will be made if warm periods occur during the winter months. Excellent growth is made under the high rainfall conditions of North Queensland, but the most extensive use of green panic so far has been made in the Central Burnett district, which is in the 28-30 inch rainfall zone.

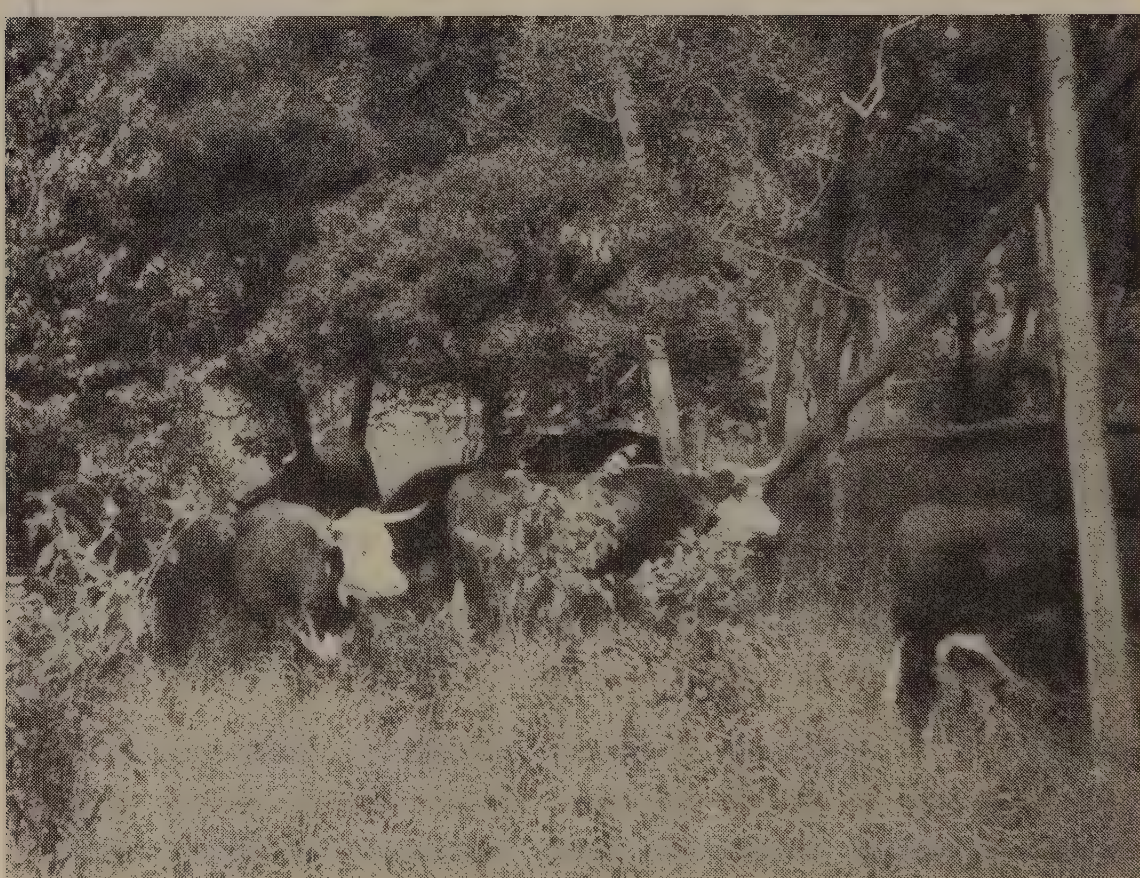


Plate 18.

Green Panic in a Shaded Cattle Camp on "Madoora," Gayndah.

Its ability to withstand dry conditions was shown in the Central Burnett during the drought of 1946. Many Rhodes grass stands were completely killed, while on the other hand, neighbouring green panic stands under similar conditions survived until the drought broke, when normal regrowth appeared.

Green panic also exhibits some tolerance for shade and this characteristic may be exploited in several practical ways. For example, stands of this grass in the shelter of forest growth will be protected to some extent from frosts; thus the growing season is prolonged and the period of palatability of the grass lengthened into summer. Experience has shown also that it is capable of competing with lantana and under certain conditions may eventually suppress this pest.

Soils.

The grass has been grown on a number of soil types, ranging from deep, fertile volcanic softwood scrub soils to the soil types of low fertility levels represented by uncleared ironbark and spotted gum ridges and wattle slopes. As would be expected, best growth is made on the more fertile soils, but its ability to grow in competition with the worthless wire and spear grasses on the harsher country is a valuable asset.

Seed.

As with Guinea grass, the seed usually shatters from the head as it ripens. Since most commercial seed harvesting methods involve removing the whole seedhead, much of the material is always immature

Plate 19.

Green Panic on Poor Spotted Gum Country on "Madoora," Gayndah.

Plate 20.

Extensive Green Panic Pasture on Scrub Land near Gayndah.

and viability of most commercial seed is low. The heads may be cut, cured in small heaps and threshed by hand. In some areas a reaper and binder is used and the grass is cured in stooks before threshing. Higher quality seed is usually obtained when the heads are hand stripped in the field, and similar results have followed the use of properly adjusted wheat headers.

Good stands have been obtained using seed of only 5 per cent. germination at the rate of five pounds per acre. Tests being conducted by the Department of Agriculture and Stock indicate that seed showing 3 per cent. germination at harvest may after storage for 16 months give a germination percentage of 17 per cent. The minimum germination permitted for green panic seed under the Seeds Acts is 3 per cent.

Planting.

As is the case with most sown pasture plants, green panic does best if planted in disturbed soil or in the ashes of a scrub burn. When treated as a crop and sown on well prepared land with a firm seed-bed and covered to a depth of about half an inch, establishment is rapid. Should a sparse stand be obtained, the grass should be allowed to seed freely, when natural establishment will occur. Examples are known where green panic has slowly dominated Rhodes grass pasture in scrub burns.

A planting rate of four to five pounds per acre is recommended. This will entail the expenditure of £1 to 26s. per acre for seed (1950 costs), depending on seed prices. As the very young seedlings are sensitive to hot dry weather, it is advisable to plant during the summer wet season of January to March.

Satisfactory stands have also been obtained when the grass is sown with a cover or nurse crop. For summer plantings, Sudan grass has been successful and in autumn sowings, oats have been used. Planting in maize at the time of the last interrow cultivation is also practised with success on the Atherton Tableland.

Plate 21.

Three Months' Old Green Panic on Cultivation at Peachester.

The grass in the centre foreground is buffel grass.

On sloping grass lands, contour pasture furrows can be used to provide the seed-bed, and in this way a nucleus of the grass can be established through large paddocks.

In the tropics under high rainfall conditions, the tropical pasture legumes centro (*Centrosema pubescens*) and puero (*Pueraria phaseoloides*) are showing promise in trials in combination with green panic. No seed of either of these legumes is available commercially yet.

In the sub-tropical and temperate zones lucerne or phasemy bean (*Phaseolus lathyroides*), and in certain areas where frost is not serious, Townsville lucerne (*Stylosanthes sundaica*) could be considered. A satisfactory sowing rate for lucerne is 1 lb. per acre. Townsville lucerne should be oversown without covering the seed, using about 2 lb. per acre. Phasemy bean may be used at 2-3 lb. per acre; seed of this legume is not available commercially, but can be collected by hand from natural stands in many localities.

Management.

Newly established green panic pastures should not be grazed until the plants have made good growth and are firmly rooted. Where germination has been poor, the grass should be allowed to seed before feeding off.

Green panic grows at a rapid rate during the flush season, hence it is advisable to graze heavily for short periods with resting intervals to allow regrowth. This type of management with related grass

varieties has worked satisfactorily in North Queensland, where high carrying capacity over a long period has been maintained, and the same general practice of allowing resting intervals should be applied wherever green panic is grown. Continuous heavy grazing is detrimental to any good pasture. The Guinea grasses will succumb to this treatment, but green panic is thought to be more tolerant of heavy stocking than common Guinea grass. Alternatively, where pronounced under-stocking is commonly practised, it may happen that the stock will destroy the green panic through preferential grazing, leaving less palatable and less suitable grasses as dominants in the pasture.

While evidence is conflicting regarding the relative palatability of green panic and Rhodes grass when both are young, it is generally agreed that as the grasses mature, green panic is more attractive to stock. It is more palatable than the common native grasses and moreover has been found to retain its attractiveness into the autumn and early winter months for a longer period than most other summer growing species.

While actual feeding trials have not yet been conducted, the experience of farmers growing the grass indicates that cows produce satisfactorily when grazing on green panic, but as with all grasses, nutritive value drops as the plant matures. The variety's ability to make fresh regrowth during warm periods in the winter months enhances its food value, as the new growth will be more nutritious than the matured stems and leaves.

PLANT PROTECTION

The Sweet Potato Weevil.

J. A. WEDDELL, Assistant Senior Entomologist.

THE sweet potato weevil (*Cylas formicarius* Fabr.) occurs as a destructive pest of sweet potatoes almost wherever the crop is grown, and to this Queensland is no exception. The eggs of the insect are laid in the stems of the plant, in the tubers in the ground, or later in stored tubers. The white legless grubs that hatch grow to three-eighths of an inch in length. This is the destructive stage; the stems of the plant may be tunnelled and the tubers thoroughly riddled. The insects pupate in small oval cavities in the tubers and after a brief period the adult beetles emerge. These are slender weevils, about a quarter of an inch in length, and ant-like in general shape; the predominant body colour is metallic greenish blue, with an orange thorax.

In warm weather the insect can complete its life cycle in four weeks, but the adult weevils live for several months. Once infestation commences serious damage to tubers may quickly follow. The illustration in Plate 22 is of portion of a tuber freshly dug from an infested crop. Apart from the blemished appearance, infested tubers are inedible owing to an unpleasant bitter flavour.

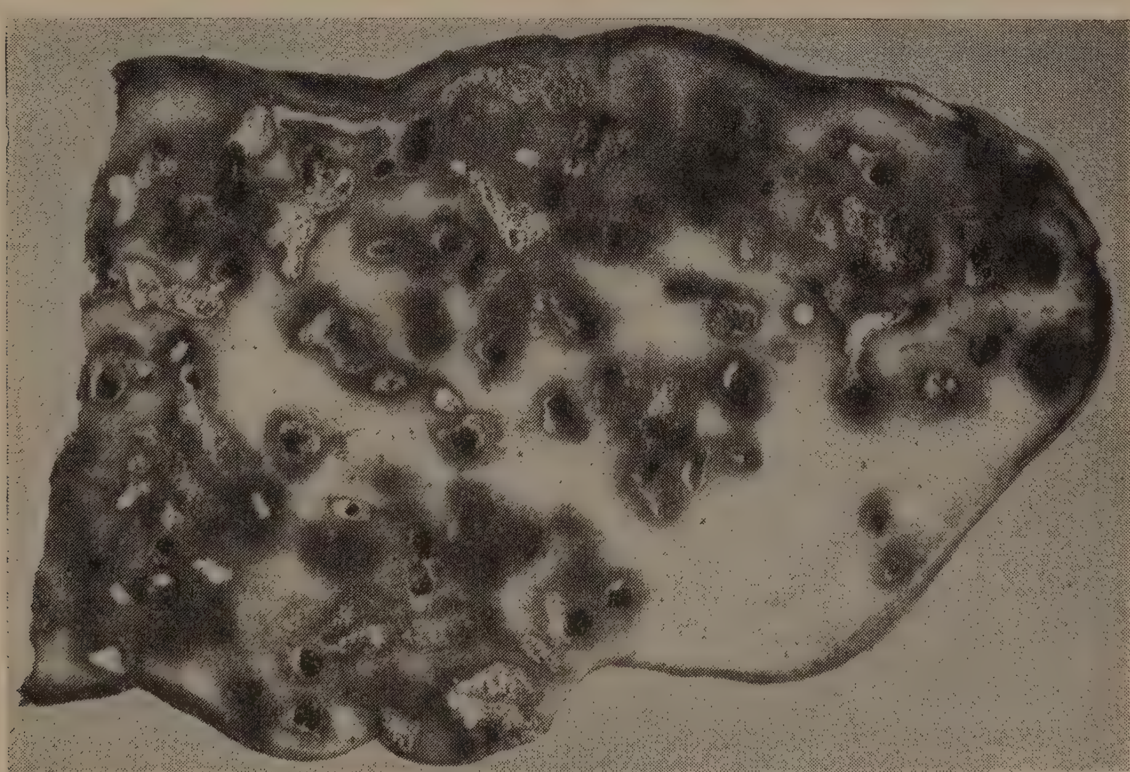


Plate 22.

Section of Newly-dug Sweet Potato Riddled by Grubs of the Sweet Potato Weevil.

As the insect is more or less established in areas where sweet potatoes are grown, there are several possible means of infestation in new plantings. An obvious source is of course the planting material, whether this consists of tubers or cuttings. Risk is incurred if the area selected for the next planting is on or adjacent to land carrying the remnants of an earlier crop. Further, weevils may migrate from old infested tubers that have been stored on the farm. Recognition of these facts suggests suitable measures to reduce risks of infestation. In addition, it has been found that under storage conditions the adult weevil is susceptible to the higher concentrations of DDT.

Control Measures.

Recommended measures to reduce losses from the sweet potato weevil are therefore as follows:—

(1) If sweet potatoes have been grown previously on the farm, the old area should be grazed or burnt off. Follow this by at least two ploughings to assist in destroying crop residues in the ground.

(2) Select the area for the new planting as far as possible from the previous crop. Do not follow sweet potatoes with sweet potatoes.

(3) Do not take planting material from the remnants of an old crop. Obtain tubers for planting from a weevil-free crop. As a further precaution, treat these tubers thoroughly with DDT at the rate of half a pound of DDT 10 per cent. dust to each bag of tubers.

(4) If a seed-bed is used, it should be established as far as possible from the main crop area, and destroyed as soon as the required cuttings have been obtained.

(5) When digging sweet potatoes, clean tubers should be bagged and the bags stitched and removed from the field as soon as possible.

(6) If the bags are to be stored temporarily on the farm, the shed should first be cleaned and then sprayed thoroughly with 1 per cent. DDT.

(7) Infested tubers may not be accepted raw by stock because of the bitter taste, but if only moderately infested they may be fed after boiling.

The Protection of Stored Seed with Dusts.

W. A. McDOUGALL, Senior Entomologist.

SEVERAL insects, chiefly the rice weevil (*Calandra oryzae* L.) and bruchids, attack seeds of various kinds and infestations often commence in the field, where control is not practicable. If these pests are left unchecked after harvesting, the stored seed material may become valueless for planting purposes.

Current rules for the certification of seeds under "*The Seeds Acts*, 1937-41," provide that before any of the undermentioned seeds will be certified they **must be treated with benzene hexachloride (BHC) dusts as follows:—**

Kind of Seed	Strength of BHC Dust (gamma isomer).	Rate of Dusting (per bushel).
	Per cent.	oz.
Hybrid Maize	1·0 ..	3
French Bean	1·0 ..	3
Grain Sorghum	0·5 ..	3

These rates should *not* be exceeded. Thorough mixing is essential to ensure a coating of dust on every grain.

Some growers harvest maize as early as practicable, husk and store the cobs until sufficiently dry to shell. To check weevil attack during this storage, the cobs may be dusted as above, and stored away from direct sunlight. After shelling it will be necessary to redust.

Seed dusted with BHC should not be fed to poultry.

Previously carbon bisulphide had been used for certified seed, and when treatments were carried out correctly it gave satisfactory results. At present, this fumigant is not readily available; however, a single dusting with BHC has been found a convenient substitute, and typical results are illustrated in Plates 23 and 24.

BHC dusts may be used successfully with most seeds, and germination will not be affected. The lighter strength of 0·5 per cent. gamma isomer should be used with the smaller seeds such as wheat, oats, barley and grain sorghum. Commercial BHC has a musty and distinctive odour, but deodorised BHC as a seed protectant on a large scale would be costly. If the ordinary BHC is found objectionable or is not readily available, a DDT dust of not less than 2 per cent. para para isomer will also give satisfactory results with non-certified seed. DDT is slower acting than BHC, and although the ultimate protection by either dust is good, a few weevils may survive in the seeds for some time after DDT dusting. The presence of these few living weevils would condemn seed submitted for certification.

The dusting rate of 3 oz. per bushel should not be exceeded. Excess dust is unnecessary for pest control, and it certainly detracts from the appearance of the seed (note the correctly dusted seed in Plates 23 and 24).

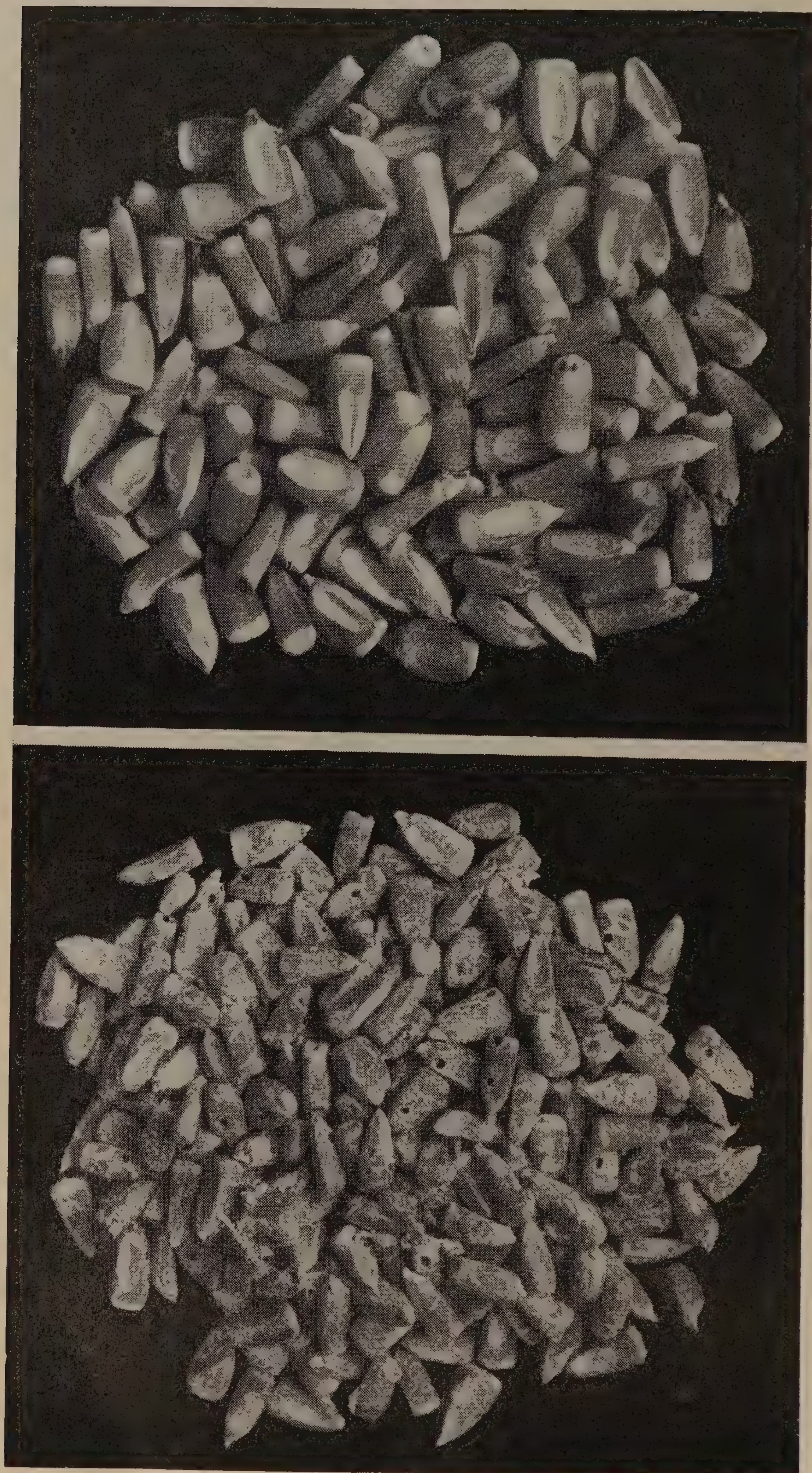


Plate 23.

BHC Dusting of Maize Seed.—Top, dusted maize after six months' storage; bottom, untreated seed from the same harvest after three months' storage.

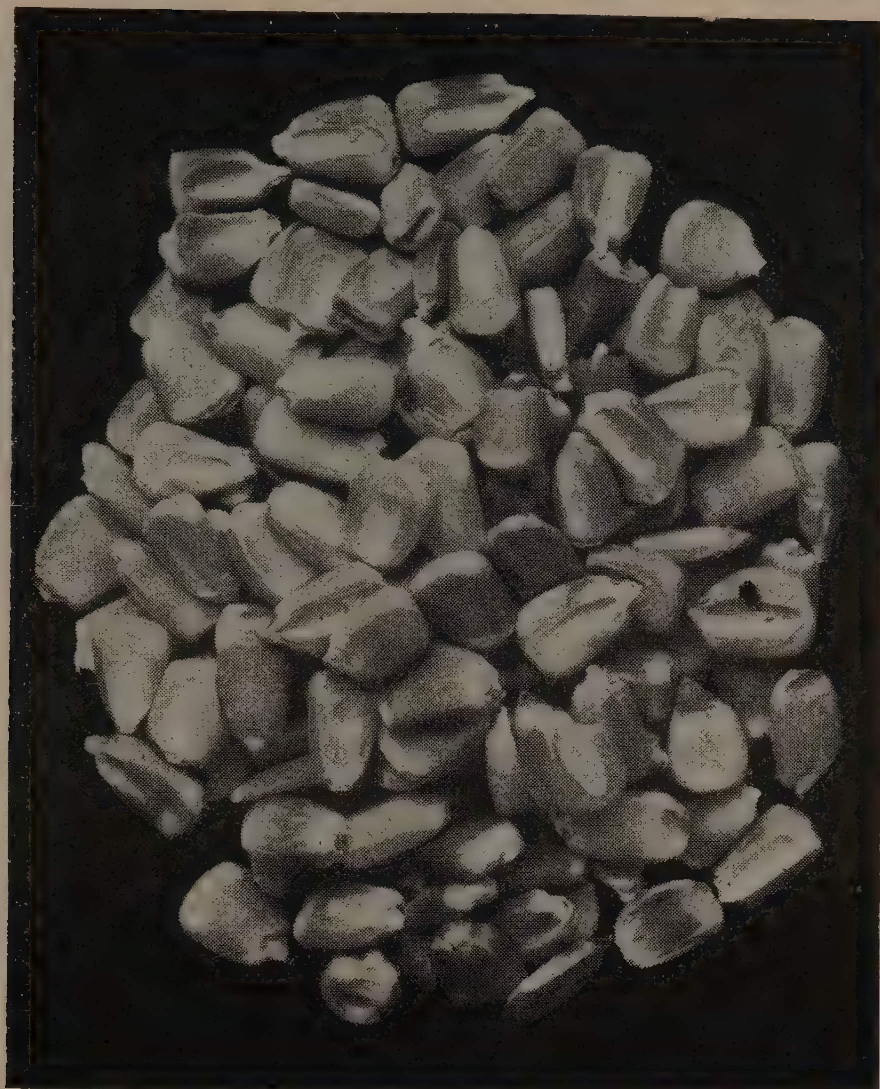


Plate 24.

BHC Dusted Maize After 16 Months' Storage.—Untreated maize put into storage at the same time was completely destroyed by weevils in four months.

DEVELOPING THE WALLUM.

The Minister for Agriculture and Stock (Hon. H. H. Collins) stated recently that, following new developments in research methods both in Australia and overseas, officers of his Department are now engaged in a close examination of the potential uses to which the many thousands of acres of "wallum" soils extending along the coast of Queensland might be put. To this end, by the use of aerial photography and ground examinations, various soil zones are being mapped and samples of the soil from various localities examined. In addition, the pastures and other plants growing on these soils are being analysed and these analyses correlated with animal health conditions of the various localities.

Some most useful data have been obtained and it is now known that phosphorous and copper are key elements in the development of much of the country. The deficiency of copper in these pastures has been shown to be correlated with a deficiency of this element in the stock, and the animals have in several cases been found to respond to administration of copper salts. Suitable methods of treating the pastures themselves are now being studied. Low phosphate concentration in the blood of stock results in unthriftiness, low production in dairy cows, infertility, and the habit of bone chewing.

This work will be continued, as it is felt that this class of country is destined to play a much more important part in food production than it does at present, or was envisaged a few years ago. The relatively good rainfall conditions of this coastal strip favour agriculture and the development of improved pastures.

Brucellosis Testing of Swine.

The Department of Agriculture and Stock is operating a scheme whereby pig herds are tested at intervals for the occurrence of swine brucellosis (contagious abortion).

A herd listed by the Department as "brucellosis tested" is one in which all such animals as may be determined by the Director of the Department's Division of Animal Industry have been subjected to two successive tests for brucellosis, at intervals determined by him, without any positive reactors being found.

In order for a herd to be retained on the list of Tested Herds, a semi-annual or annual re-test of the herd, as determined by the Director, is required. If at a re-test any animal gives a positive reaction to the test the herd is removed from the list; it is not listed again until subsequent tests, as determined by the Director, have been carried out.

TESTED HERDS. (As at 18th June, 1951.)

Breed.	Owner's Name and Address of Stud.
Berkshire	S. S. Ashton, "Scotia" Stud, Pittsworth
	J. J. Bailey, "Lucydale" Stud, East Greenmount
	S. Cochrane, "Stanroy" Stud, Felton
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	G. Handley, "Handleigh" Stud, Murphy's Creek
	J. L. Handley, "Meadow Vale" Stud, Lockyer
	R. G. Koplick, "Melan Terez" Stud, Rochedale
	H. V. Littleton, "Wongalea" Stud, Crow's Nest
	O'Brien and Hickey, "Kildurham" Stud, Jandowae East
	E. Pukallus, "Plainby" Stud, Crow's Nest
	G. C. Traves, "Wynwood" Stud, Oakey
	E. Tumbridge, "Bidwell" Stud, Oakey
	Westbrook Farm Home for Boys, Westbrook
	H. W. Wyatte, Rocky Creek, Yarraman
	H. M. State Farm, "Palen Creek," Palen Creek
	A. R. Ludwig and Sons, "Cryna" Stud, Beaudesert
	H. H. Sellars, "Tabooba" Stud, Beaudesert
	F. Thomas, "Rosevale" Stud, Beaudesert
Large White	H. J. Franke and Sons, "Delvue" Stud, Cawdor
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	F. L. Hayward, "Curyo," Jandowae
	J. A. Heading, "Highfields," Murgon
	K. B. Jones, "Cefn" Stud, Pilton
	R. G. Koplick, "Melan Terez" Stud, Rochedale
	R. Postle, "Yaralla" Stud, Pittsworth
	E. C. Smith, "Smithfield" Stud, Coomera
	E. J. Bell, "Dorne" Stud, Chinchilla
	A. G. Fry, "Birubi" Stud, Dalby
	M. E. Myers, Halpine Plantation, Kallangur
	L. C. Lobegeiger, "Bremer Valley" Stud, Moorang, *via* Rosewood
	J. H. G. Blakeney, "Talgai" Stud, Clifton
Tamworth	S. Kanowski, "Miecho" Stud, Pinelands
	N. R. Potter, "Actonvale" Stud, Wellcamp
	D. F. L. Skerman, "Waverley" Stud, Kaimkillenbun
	A. C. Fletcher, "Myola" Stud, Jimbour
	L. C. Lobegeiger, "Bremer Valley" Stud, Moorang, *via* Rosewood
	P. V. Campbell, Lawn Hill, Lamington
	Salvation Army Home for Boys, Riverview
	F. Thomas, "Rosevale" Stud, Beaudesert
Wessex Saddleback	W. S. Douglas, "Greylight" Stud, Goombungee
	D. Kay and P. Hunting, "Kazan" Stud, Goodna
	E. Sirrett, "Iona Vale" Stud, Kuraby
	C. R. Smith, "Belton Park" Stud, Nara
	H. H. Sellars, "Tabooba" Stud, Beaudesert
	H. Thomas, "Eurara" Stud, Beaudesert

The Cleaning and Sterilizing of Dairy Utensils and Equipment.

W. F. SCHUBERT, L. E. NICHOLS, and E. B. RICE, Division of Dairying.

THE proper cleaning and sterilizing of utensils and equipment are essential for the production of high quality milk and cream. Where cleaning is skimped or omitted, milk films form on the surfaces of utensils, milkstone builds up in the milk lines of the milking machine, and yellow slime accumulates in the interior of the rubber connections. These films and residues form excellent breeding grounds for bacteria which affect the quality of dairy produce. As long as they are present, the work of sterilization is largely nullified.

DEFINITION OF TERMS.

There still seems to be a certain amount of confusion regarding the terms cleaning and sterilizing. They may be defined as follows:—

"*Cleaning*" is the removal of all milk and other residues.

"*Sterilizing*" is the destruction of bacteria by heat (steam or hot water) or by chemicals, such as chlorine and quaternary ammonium products.

Cleaning and sterilizing are separate and distinct operations. Cleaning is the more fundamental of the two processes and possibly the more important. However, both cleaning and sterilizing are essential for efficient results. In practice, the removal of films and residues also results in the removal of numbers of bacteria associated with them and most cleaners (detergents) have some power to kill or suspend the growth of bacteria. Sterilization without cleaning is a waste of effort and will eventually cause the down-grading of milk and cream. Sterilizing may be regarded as the finishing process. It is a "must" in the production of high quality dairy produce.

FACILITIES AND EQUIPMENT NECESSARY.

Cleaning and sterilizing cannot be effectively carried out unless there is an ample, and preferably a permanent, supply of good quality water available at the dairy (Plates 25 and 26). The source of supply may take the form of underground water storage tanks, streams, or

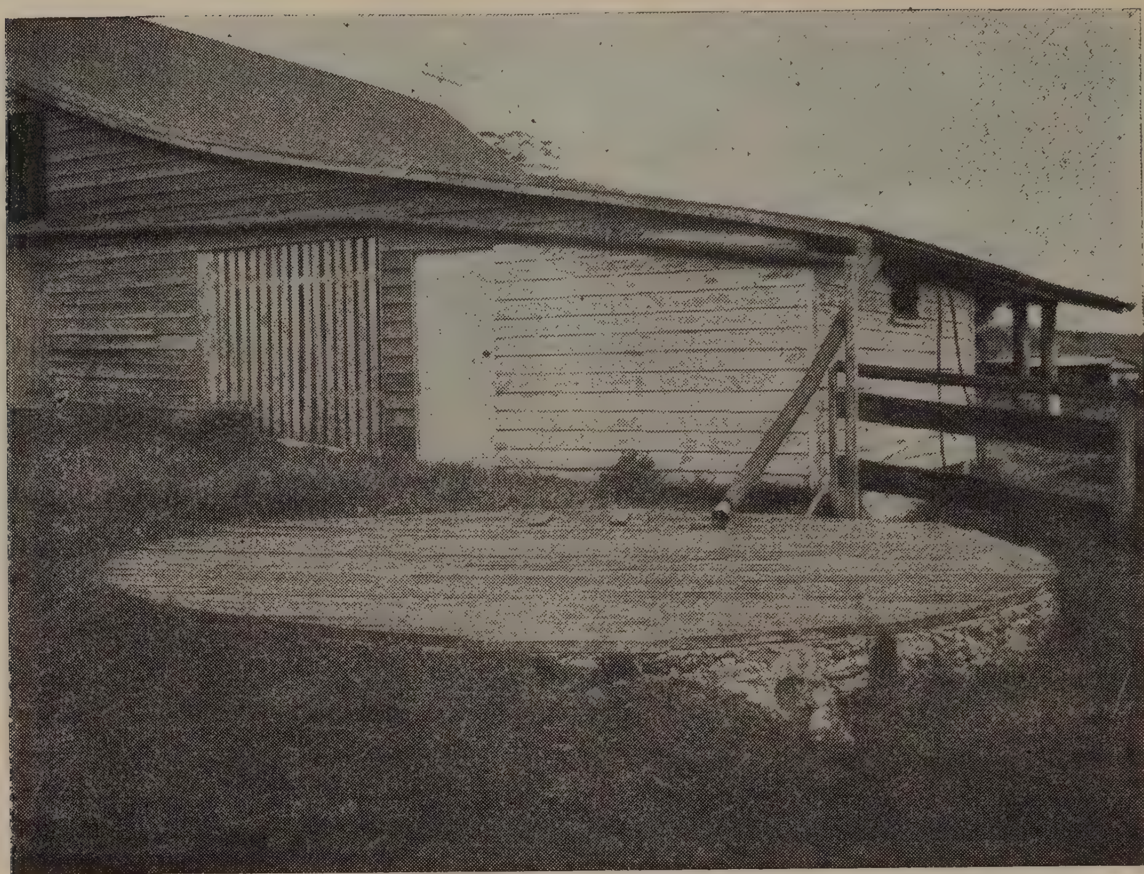


Plate 25.

A 20,000 Gallon Underground Water Storage Tank From Which Water May be Pumped to an Overhead Tank for Dairy Purposes.

Plate 26.

An Overhead Tank From Which Water May Be Reticulated to Various Points.

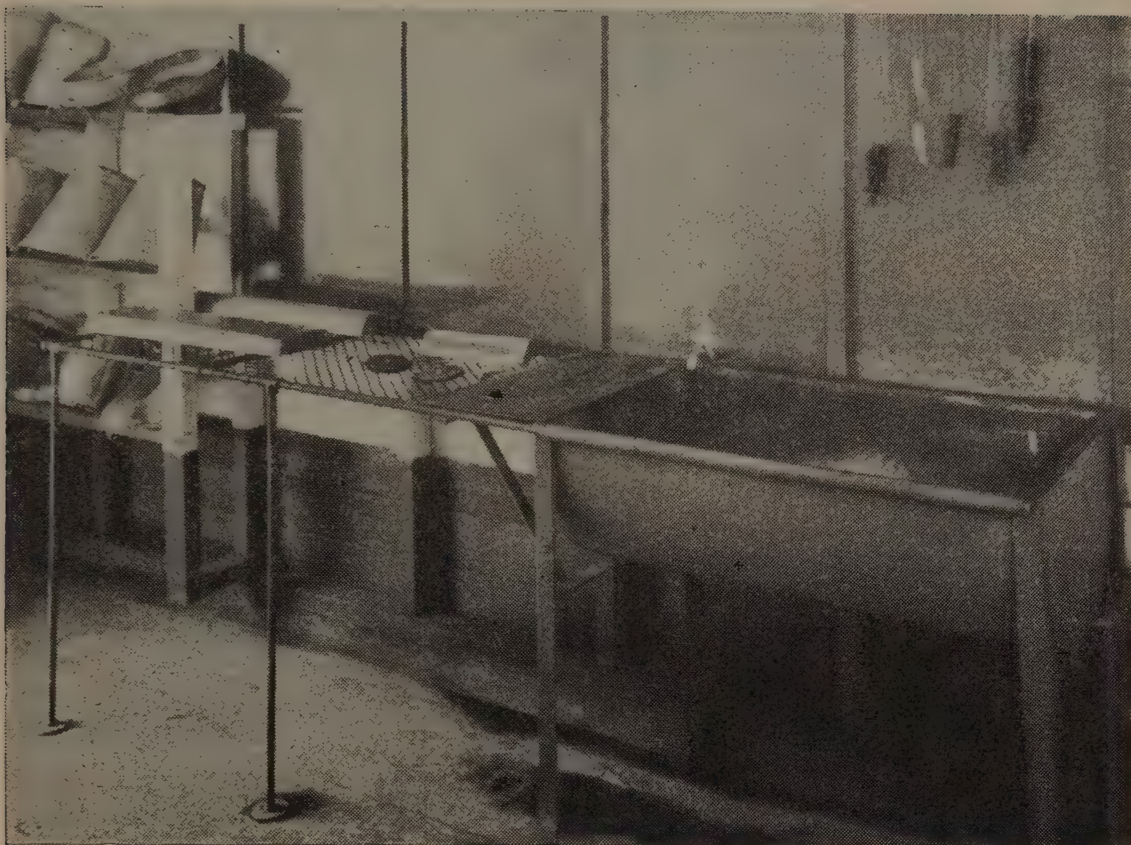


Plate 27.

A Wash-up Trough and Draining Rack.—Note brushes used in the cleaning of dairy utensils hung on the wall.

Plate 28.

A Solidly Constructed Angle Iron Storage Drying Rack.

more often, wells and bores. The wash-up section of the dairy buildings should be provided with a well-drained concrete floor. Certain equipment in the milking shed and dairy is absolutely essential. This should include a hot water supply, a sufficiently large wash-up trough (Plate 27), a metal, preferably a pipe, drying rack (Plate 28), and convenient sized brushes for all purposes.

Properly designed units for ensuring an *ample supply of boiling water* and the generation of steam are now available on the market as *electric hot water units* (Plate 29) and *steam sterilizers* (Plate 30).

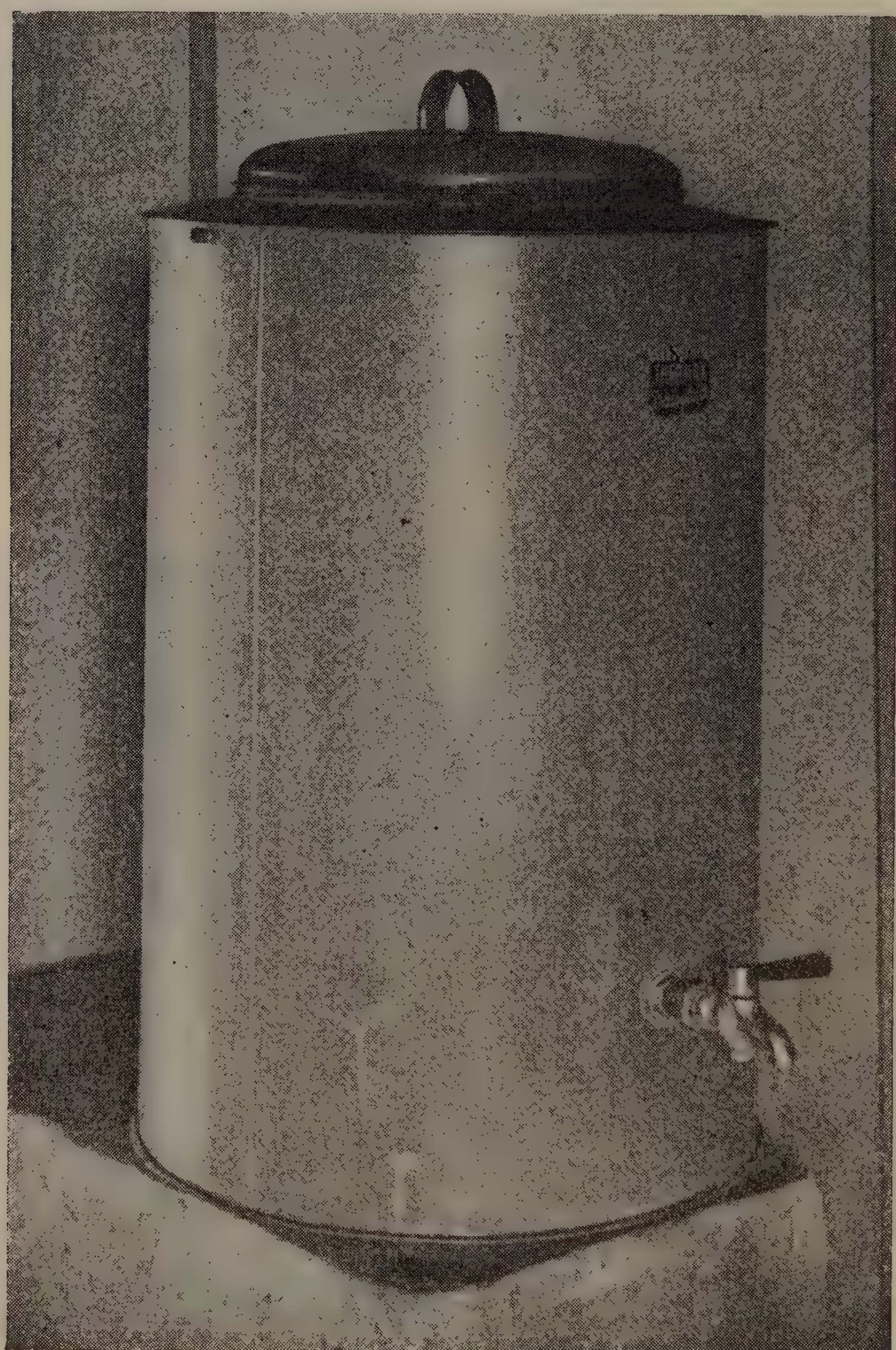


Plate 29.
An Electric Water Heater Suitable for the Dairy Farm.

The outlay involved in their purchase and installation should be regarded as an essential expenditure in the fitting up of dairy farm premises.

In the case of a small farm without a milking machine, boiling water can be supplied from a built-in copper of at least 12 gallons capacity (Plate 31).

On farms where electric power is available, the use of automatically controlled electric hot water storage systems is coming into favour. These units are thermostatically controlled and the use of a switch, which the farmer operates before milking begins, ensures that the water will be at boiling point by the time washing-up is commenced. Suitable units can be usually purchased through agents in local towns or direct from the manufacturers. A unit of at least 18 gallons capacity suffices for up to a 3-unit milking machine; a proportionately increased capacity is required for larger machines.

Cleaners and chemical sterilizers should be stored away from heat, light and moisture, in airtight containers placed on convenient shelves.

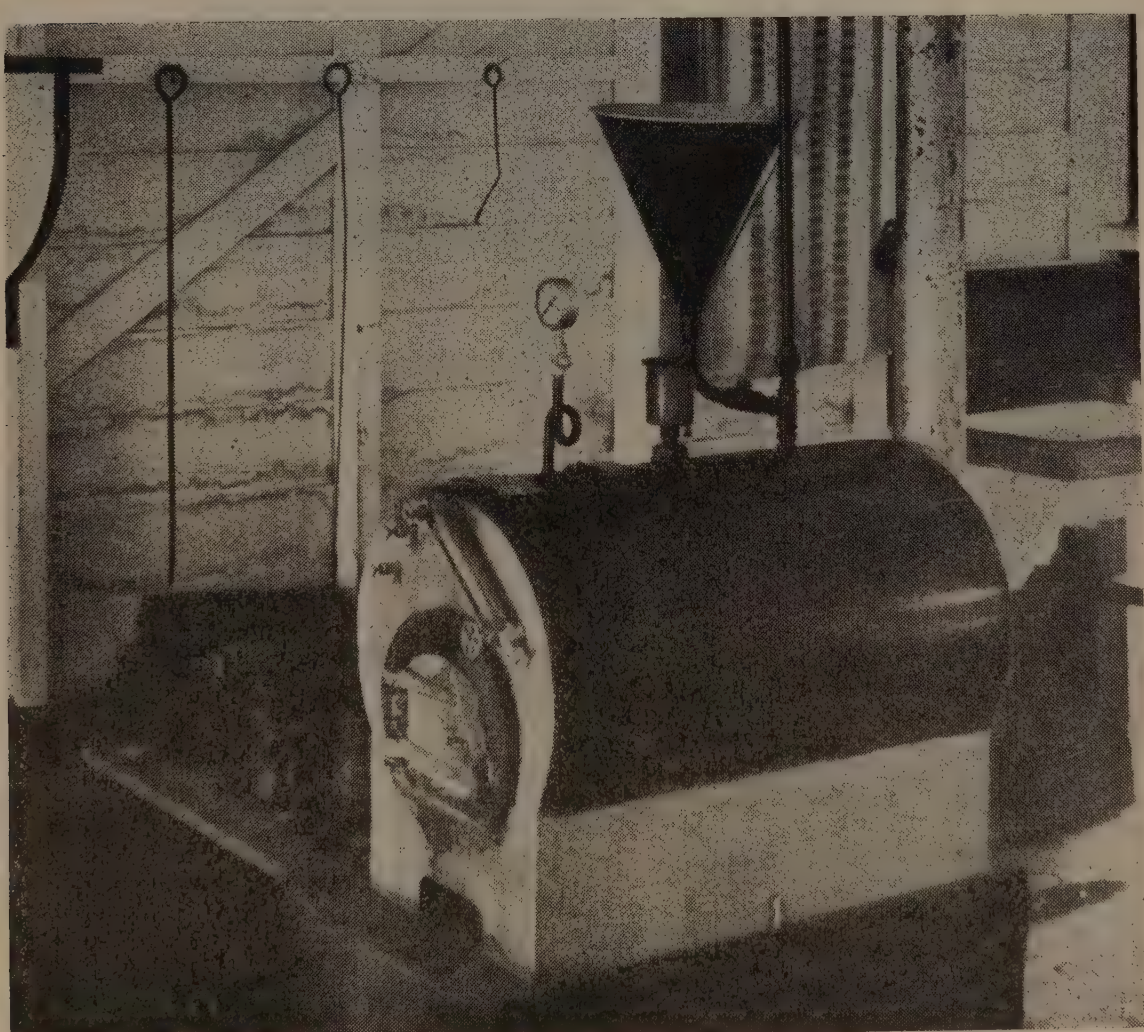


Plate 30.

A Steam Sterilizer for Dairy Farm Use.—Note also the hand wash basin and towel in the background.

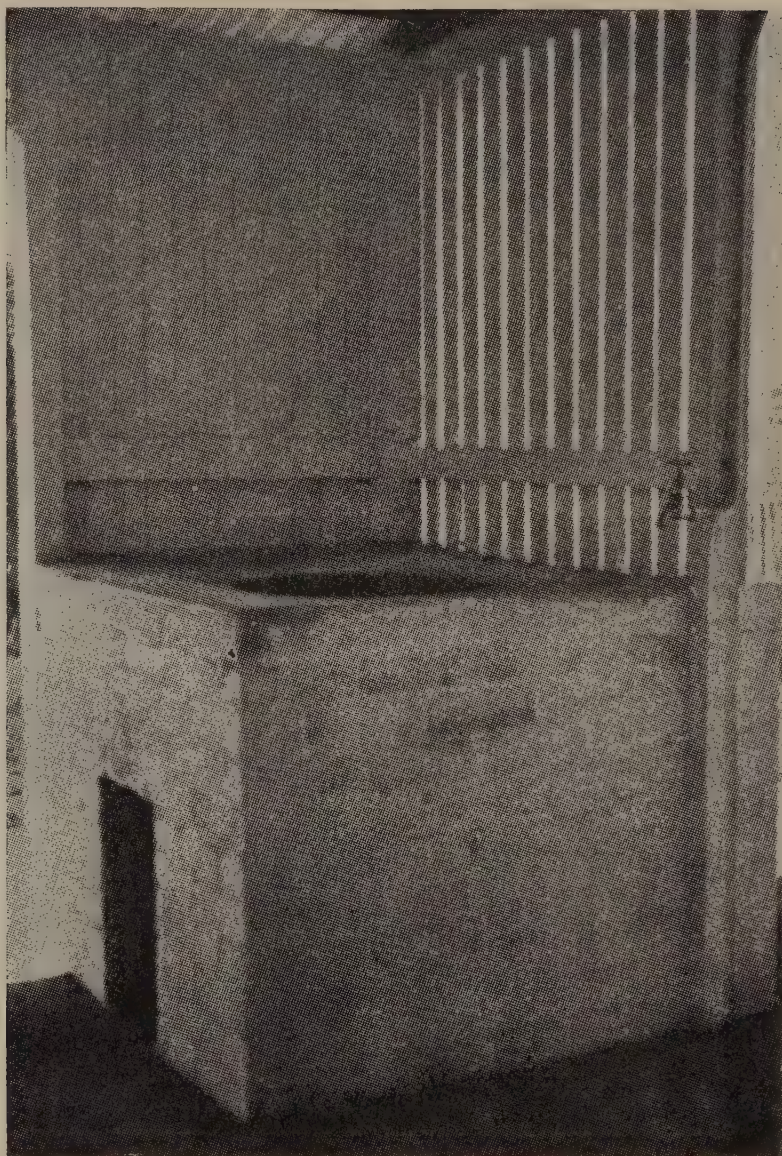


Plate 31.
A Convenient Built-in Boiler on a Dairy Farm.

RECOMMENDED CLEANERS FOR DAIRY FARM USE.

The following cleaners (detergents) have been found satisfactory.

(*a*) Caustic soda.—Strength, $\frac{1}{2}$ oz. (one dessertspoonful) per 4 gallons of water. Caustic soda solution can be used for cleaning machines, but owing to its severity on the hands is unsuitable for utensils to be washed by hand.

(*b*) Sodium carbonate (washing soda).—Strength, 3-4 oz. (3 full tablespoonfuls) per 4 gallons of water.

(*c*) Soda ash.—Strength, 1-2 oz. (1 full tablespoonful) per 4 gallons of water.

(*d*) Trisodium phosphate.—Strength, 2 oz. (2 tablespoonfuls) per 4 gallons of water.

(*e*) Sodium silicate or sodium metasilicate.—Strength, 1-2 oz. (2 full tablespoonfuls) per 4 gallons of water.

There are also many satisfactory proprietary detergents which many farmers prefer to use. Farmers should bear in mind that a good cleaner should have a combination of desirable properties, which include—

(1) Wetting-power.

(2) Dissolving action on milk residues.

(3) Power of emulsifying fat.

(4) Ease of rinsing from the equipment.

(5) Water-softening action.

(6) Minimum corrosive action.

All these properties are seldom attained in a single chemical and therefore a good cleaning mixture should combine the good properties of two or more chemicals. For example, caustic soda has poor wetting-power, emulsification and rinsability and is strongly corrosive, but it will readily dissolve milk solids and is a good water softener. On the other hand, a cleaning mixture containing an alkali such as caustic soda, soda ash, trisodium phosphate, or a metasilicate, together with a wetting agent, approaches the ideal. A *wetting-agent* is a substance which when added to water gives it greater "wetting" power and thereby facilitates the removal of fat and milk solids. For certain hard waters, the inclusion of sodium hexa-metaphosphate (Calgon) is a distinct advantage.

TECHNIQUE AND PRINCIPLES.

The following technique should be applied to all dairy equipment, such as milking machine parts, separator, milk vat, cooler, milk and cream cans, buckets, strainer, strip cups, udder wash containers, &c., *after each milking.*

The cleaning of milking machines is described in a separate pamphlet obtainable on application to the Department or any local officer of the Division of Dairying.

Cleaning.

1. *Cold Rinse.*—Immediately after use, rinse all utensils and equipment with an ample supply of cold or lukewarm water.

Reason.—Once milk has been allowed to form a film on the surface of utensils, whether by drying in air, by coagulation, or by heat, removal becomes extremely difficult. Hence the importance of rinsing all utensils immediately after use with cold or luke-warm (not hot) water, and in good quantity. Hot water melts the fat and gives a greasy film. Very cold water hardens the fat. So probably the best temperature is one between 80°F. and 100°F. Hard water makes cleaning more difficult. Where such is evident a sample of the water may be forwarded to the Dairy Research Laboratory, Department of Agriculture and Stock, Brisbane, for analysis and advice on treatment to remove the hardness.

2. *Washing.*—Scrub the utensils in water which is not uncomfortably hot to the operator and contains an approved detergent (cleaner).

Reason.—The detergent solution acts in four ways:—

(*a*) by softening the water, making cleaning easier;

(*b*) by breaking down the fats and milk solids in the residual milk;

(*c*) by emulsifying and deflocculating the fat and milk solids remaining on the equipment: and

(*d*) by washing away the broken-down and loosened milk constituents.

Scrubbing with suitable brushes is necessary to provide mechanical force. (Under no circumstances should cloths be used in the cleaning operations). In addition, detergents, by facilitating the mechanical removal of films, also are of some importance in the removal of bacteria.

3. *Hot-water Rinse.*—Rinse utensils in boiling water.

Reason.—To remove detergent solution from surfaces of utensils and equipment and so prevent their possible corrosion from residual alkali.

Sterilization.

4. *Sterilizing after Cleaning.*—In dairy-shed practice sterility in the absolute bacteriological sense cannot be achieved, so it is necessary to be content with what is called "commercial" sterility or "near sterility."

Reason.—Sterilization at this stage is usually effected by heat—boiling water or steam—to destroy bacteria which have survived the cleaning.

Such a method of final heat treatment also ensures that the equipment after use is left thoroughly dry, thus preventing bacterial development between milking operations.

Boiling Water.—The practicability of using boiling water is determined by—

(*a*) the number of utensils to be sterilized; and

(*b*) the size of the farm copper.

For good results, the utensils must be completely immersed in water at a temperature of not less than 180°F. for 2 minutes or not less than 170°F. for 10 minutes. Periodically, temperatures should be checked with a thermometer.

In practice the use of "boiling" water for sterilizing is rarely thoroughly efficient, as often the water is not kept boiling and the quantity provided is inadequate.

Steam.—The use of steam offers several advantages—

(*a*) it is effective and convenient;

(*b*) there is a margin of safety so necessary in practice;

(*c*) it is less subject to failure due to the human element;

(*d*) as pure water is its only product there is no risk of contamination of the milk with objectionable substances;

(*e*) time and temperature are about the only variables involved.

Every dairyman interested in efficiency should install a steam sterilizer. It is, however, essential for effective results with cans, milking machines, &c., that they be steamed for at least two minutes.

In some countries certain chemicals, such as chlorine compounds and quaternary ammonium compounds, are used for sterilizing dairy utensils after cleaning. This practice is, however, not yet recommended in Queensland.

Storage of Utensils.

5. *Draining and Drying.*—After sterilization, all utensils should be allowed to drain and dry and be protected from contamination, by storing either on a metal draining rack in a dust-free area or in a metal cabinet, until required again.

Reason.—Any bacteria which survive efficient cleaning and sterilizing will be few and of inert types. In dry utensils they will be unable to increase in numbers, as moisture is essential for bacterial multiplication. However, the least trace of moisture in any utensil suffices to permit unrestrained multiplication of bacteria.

Treatment of Utensils before Re-use.

All utensils and milking equipment should be rinsed just before each milking begins in order to destroy bacteria which may have lodged and multiplied in them in the period between milkings. For this purpose a chemical sterilant is added to the rinse water. This pre-rinse with a chemical sterilant not only destroys bacteria which have multiplied in the equipment, but also eliminates the chance of contamination from untreated tank water adjacent to the dairy premises, aids in cooling the equipment and eliminates the possibility of corrosion which would normally occur if a chlorine sterilant were used after the normal cleaning operations.

Chlorine compounds dissolved in luke-warm water are mainly used for this purpose. They are effective, non-tainting and non-corrosive when used as instructed. It is important, however, to use them strictly in accordance with the instructions of the manufacturers and certainly not in excess of 50 to 100 parts per million of available chlorine in the rinse solution.

Quaternary ammonium products are also being used overseas as sterilants and are at present being tried out under Queensland conditions. Their use closely resembles that in vogue for chlorine compounds. They are non-corrosive.

Removal of Milkstone from Dairy Equipment.

If any milkstone is visible on utensils after the detergent treatment, this must be removed by weak acid, otherwise efficient sterilization will not be obtained. The weak acid solution should comprise three teaspoonfuls of phosphoric acid in 2 gallons of hot water. If milking machines are to be treated, run the weak acid solution into the affected pipelines, plug the ends and leave for at least half an hour. It may be necessary to use steel wool wrapped around a brush to assist the removal of the milkstone after the acid treatment. Immediately following such treatment, equipment should be washed in a soda solution containing 3 oz. washing soda (or 1 oz. soda ash) in 6 gallons of hot water, followed by a plain boiling water rinse.

Repeated treatment for a number of days may be necessary for satisfactory results. Cooler, cans, &c., may be similarly treated.

The supply of phosphoric acid should be kept in a glass bottle or stone jar, otherwise corrosion of metal containers can be expected. Phosphoric acid can be purchased from most chemists.

Scale Formation.

Where scale or fur results from the use of hard water, the water should be analysed to determine if it can be economically softened. In any case where a steam sterilizer is installed, analysis of the water is a wise precaution to ensure the life of the boiler. A representative sample of at least one gallon in a clean glass container can be forwarded to the Dairy Research Laboratory, Department of Agriculture and Stock, Brisbane, for analysis and advice on the economy or otherwise of treatment.

Combined Cleaning and Sterilizing.

To prevent the chance of chain-infection or carry-over of bacteria from utensil to utensil in the cleaning process, cleaners and sterilizers are being combined overseas in the washing up process. They also are being tried out under Queensland conditions and to date have given effective results, providing the directions are carefully followed.

However, even if combined cleansing and sterilizing is adopted, the methods outlined above are not appreciably altered.

SUMMARY.

The procedure for cleaning and sterilizing dairy utensils and equipment may be summarised as follows:—

(*a*) Immediately after use, rinse with cold or lukewarm water.

(*b*) Wash thoroughly with warm water in which is dissolved a detergent (cleaner).

(*c*) Rinse off residual detergent solution with hot water.

(*d*) Near-sterilize by immersing in boiling water or by steam.

(*e*) Allow the utensils to drain and dry in an inverted position on a metal draining rack situated in a dust-free atmosphere. Do not use cloths to dry dairy utensils.

(*f*) Just prior to milking rinse all equipment with luke-warm water containing a chemical sterilant.

(*g*) If milkstone is present on utensils, remove it by the special method referred to. If hard water only is available at the dairy shed, arrange for it to be analysed in the Dairy Research Laboratory and treat it in accordance with the recommendation of the Laboratory.

The proper application of the procedures outlined will do much to ensure the production of milk and cream of the highest quality, as—

(i.) efficient cleaning of utensils will remove most of the bacteria and all food for bacterial subsistence;

(ii.) sterilizing will destroy all but a few of the most inert types which are of little importance in affecting the quality of dairy produce;

(iii.) storage in a dry condition will prevent any increase in numbers of the few residual inert bacteria;

(iv.) the pre-rinse with a chemical sterilant just before re-use will destroy any bacteria which may enter and multiply in equipment during storage between milkings.

Investigation of Plant and Animal Nutrition Problems on Springbrook Plateau.

Compiled by C. R. von STIEGLITZ, Chemical Laboratory.

LATE in 1946 a dairy farmer at Springbrook brought to the notice of the Agricultural Chemist that dairy cattle on the plateau were suffering from "depraved appetite" and infertility. He further stated that difficulty was being experienced in the growing of satisfactory fodder crops and that milk production had declined.

A preliminary examination of (*a*) the general topography, geology, and major soil types of the district, (*b*) the quality of the pastures, and (*c*) the general health of dairy cattle, was subsequently made and the following information obtained.

DESCRIPTION OF THE DISTRICT.

Topography.

Most of the country used for dairying at Springbrook is mountainous and confined to the 1,500-2,500 ft. levels. The maximum height of the plateau is 3,400 ft. Any flat areas are relatively small and enclosed by steep slopes. The area is well watered by small, swiftly running streams. Plates 32 and 33 show typical country used for dairying.

Climate and Vegetation.

The average annual rainfall is 160 inches, most of which falls in the summer months; the late winter and early spring seasons are relatively dry.

The cleared land, originally covered with rain forest, is now devoted to sown pastures of paspalum and/or kikuyu grass. These pastures have, in recent years, been infested by the white grass-eating grub (a Melonthid), and bracken fern (*Pteridium aquilinum*) invasion has, in parts, become serious.

Soils.

Two main types of soils occur. They are (i.) a dark brown loam and (ii.) a brown loam, the former being associated with rhyolite and the latter with basalt.

Typical profiles to 3 feet are:—

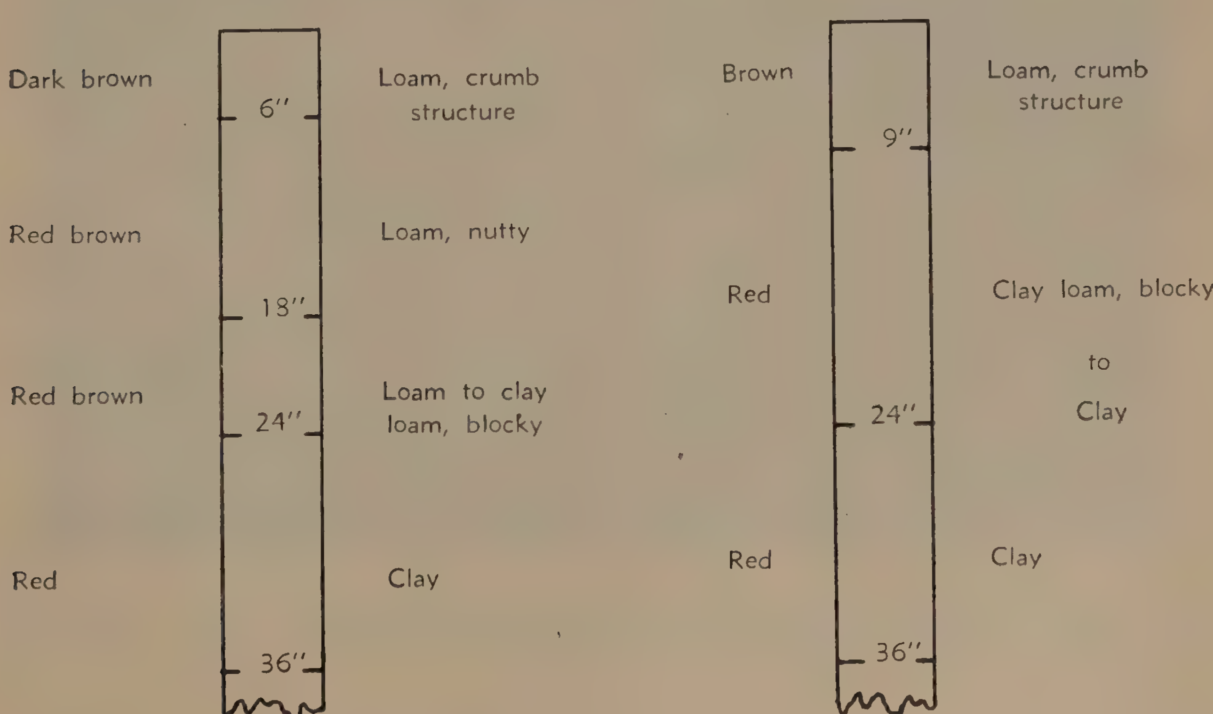


Plate 32.

Typical Springbrook Dairying Country.

Plate 33.

Portion of a Springbrook Dairy Farm.

Both soil types are easily worked in the field, although, owing to their porous nature, they dry out very quickly after rain and good conditions for cultivation are of short duration. Organic matter plays an important part in maintaining suitable moisture conditions in such soils, and once the original supply (which is normally high) becomes depleted through cultivation, the amount of water available to plants which may be stored becomes very small.

The red colour of these soils is due to high percentages of iron oxides under free drainage conditions.

Plates 34 and 35 show typical sections (or profiles, as they are called) of the soils derived from rhyolite and basalt respectively.

Plate 34.

A Profile of a Soil Derived from Rhyolite.

Plate 35.

A Profile of a Soil Derived from Basalt.

Pastures and Fodder Crops.

The pastures consist of paspalum or mixed paspalum-kikuyu grasses; in some places clovers are present.

Some farmers have attempted to improve their pastures by applying dolomite and superphosphate, and claim beneficial results; all those interviewed were of the opinion that dolomite gave better results than did pulverised limestone. On one property dolomite had been applied annually at the rate of one ton per acre and superphosphate at the rate of 2 cwt. per acre for 6-7 years; another had made similar applications for four successive years. The owner of the second property had been able to establish, successfully, under cultivated conditions, pasture consisting of lucerne, red and white clovers, and prairie grass.

Fodder crops are not normally grown and the complete failure of a crop of oats was noticed on one property. Failure was apparently due to insufficient nutrients during growth, caused largely by the effects of erosion. From field observations it seemed evident that deterioration of the pastures had been caused by (*a*) overstocking, and (*b*) the low plant food status of the soils.

Health of Stock.

At the time of the inspection, which was immediately following a particularly dry winter, dairy cattle were low in condition and were showing obvious signs of "depraved appetite." Milk production had reached a low level and the infertility index was high.

Samples of blood were drawn from four milking cows on one property and six on another, to check the levels of phosphorus and calcium. The analyses were made on the farm.

The results showed that the animals were suffering from gross phosphorus deficiency, particularly those in the second group, which was composed of high milk-producing Jerseys. The immediate use of bone meal, fed in the bails and bound with molasses, was recommended. This was to be replaced, later, with a bone-salt "lick."

The possibility of associated copper and/or cobalt deficiencies in the pasture was also considered and pastures were sampled for analysis. In addition, a sample of liver from a slaughtered beast was taken to be analysed for its copper content.

Results of Laboratory Tests.

Analyses of the soils showed that all samples were strongly acid in reaction, low in available calcium and magnesium and very low in available phosphorus; total nitrogen was high and available potash generally fair but in a few cases low. The analyses of pasture and liver for copper indicated that a deficiency of this element did not appear to be of major importance. However, in order to obviate any possibility of copper and cobalt being limiting factors, a copper-cobalt mixture was made up for one of the farmers who consented to administer it to his herd in the form of a drench. It seemed fairly obvious from the results of the soil tests that the low plant food status of the soils, particularly in relation to available phosphates, was the chief factor affecting the quality and vigour of the pastures, and that the poor quality of the pastures, in turn, caused the gross phosphorus deficiency in the animals.

INVESTIGATIONAL WORK.

Health of Stock.

In April, 1947, an inspection of stock which had been receiving the bone-salt lick since the previous visit was made and blood drawn from the six cows previously tested. A marked improvement was noticed in the condition and general appearance of the cattle. This was attributable partly to the season but largely to the effects of the bone-salt supplement. The inorganic phosphate and serum calcium figures for the blood of six animals are recorded below, in comparison with the results obtained previously.

—	Blood phosphate. mg. % P.		Serum calcium. mg. % Ca.	
	December, 1946.	April, 1946.	December, 1947.	April, 1947.
Cow No. 1	2·5	4·0	8·8	11·8
Cow No. 2	3·0	5·2	7·8	10·0
Cow No. 3	3·4	5·6	8·8	11·2
Cow No. 4	4·2	3·1	8·9	10·7
Cow No. 5	2·5	5·4	8·1	10·1
Cow No. 6	2·0	7·5	9·8	10·6

It will be seen from these results that appreciable improvement had been made in the blood phosphate content of all but one cow, and an increase in the serum calcium in all cases.

The owner of the dairy herd in which "depraved appetite" was prevalent at the time of the initial visit reported that the condition had ceased, and that milk production had increased appreciably. Infertility had largely disappeared.

It therefore seems evident that a mineral supplement of calcium and phosphate is essential for animals on paspalum and kikuyu grass pasture in this area.

A certain amount of difficulty was experienced in supplying the lick to dry stock, as, owing to the heavy rainfall in the district, appreciable loss of the lick occurs even in covered troughs. It was found practicable, however, to feed the milking cows, and also some of the dry stock, in the bails at milking time.

Soil Investigation.

As mentioned previously, soil analysis showed that both soil types contained high amounts of total nitrogen, very low percentages of available phosphates and, in most cases, fair quantities of potash. Both types were strongly acid and, in consequence, low in available calcium and magnesium.

The graph in Plate 36 shows the change in reaction of the soil brought about by the addition of various quantities of lime.

A quantity of soil of the type derived from rhyolite was taken to Brisbane for use in pot experiments, with a view to testing the locally held opinion that dolomite (which contains both lime and magnesium as carbonates) gave better results than pulverized limestone when each was used in conjunction with superphosphate.

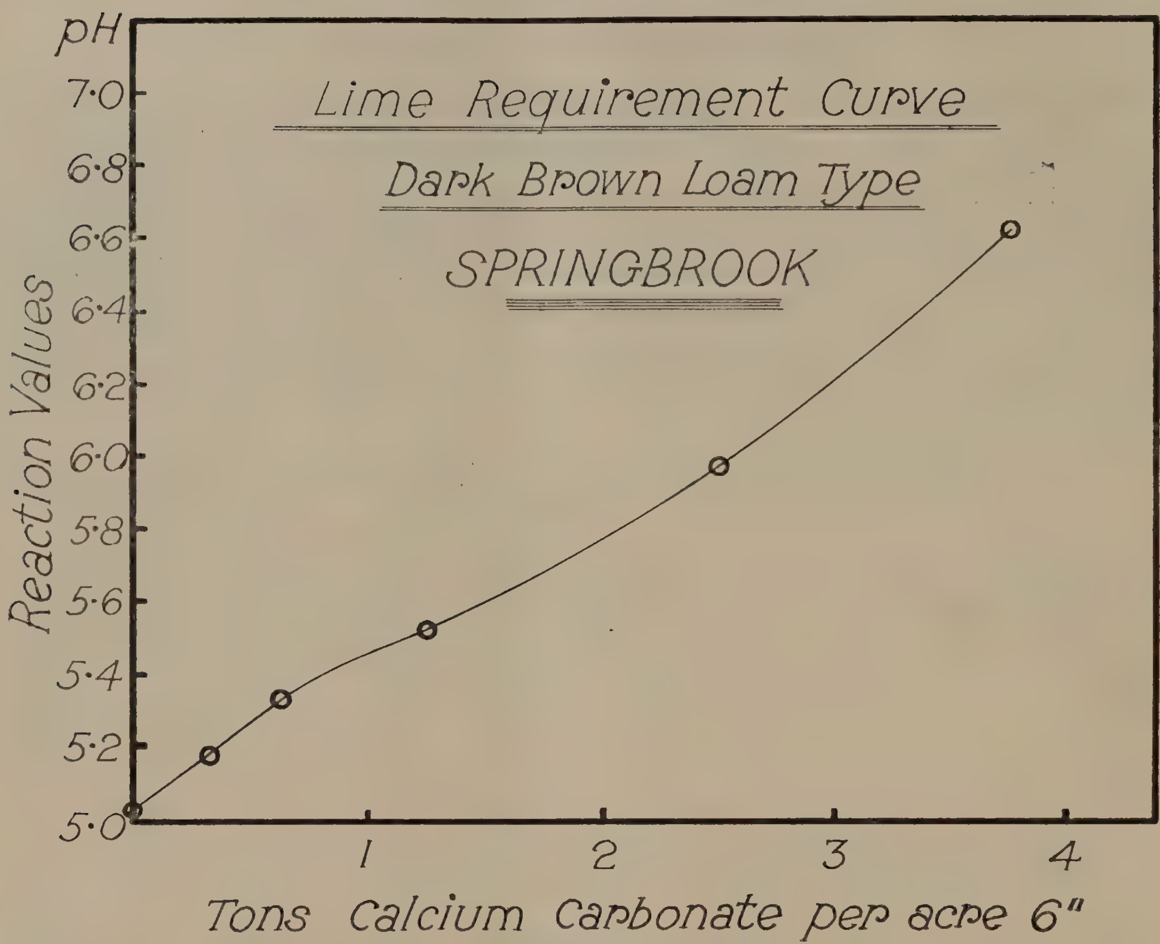


Plate 36.

Graph Showing Effect of Lime Applications on Acidity of the Soil.

The soil in all pots received superphosphate as a basal dressing and the experiment was arranged to test responses to calcium, magnesium, potassium and nitrogen. Maize was used as the indicator crop. Highly significant responses to calcium and magnesium, a significant response to nitrogen, and a response approaching significance to potash were recorded.

Plate 37.

Portion of Paspalum Paddock Selected for Experimental Purposes.

Prior to the carrying out of the pot experiments, arrangements were made for setting out an observational field trial on a portion of the pasture. The area selected (Plate 37), which was fenced off so that it could be protected from grazing as required, was a gently sloping portion of a field carrying principally paspalum.

The area was first renovated with cutaway disc harrows by discing in two directions at right angles, and then divided into 18 plots to which the following treatments were given in duplcate:—

(1) No fertilizer.
(2) Dolomite
(3) Dolomite + rock phosphate.
(4) Dolomite + superphosphate.
(5) Lime.
(6) Lime + rock phosphate.
(7) Lime + superphosphate.
(8) Rock phosphate.
(9) Superphosphate.

The lime and dolomite were applied in October, 1947, and the phosphates four weeks later.

It was hoped that natural regeneration of red and white clovers, which had been present in the pasture originally, would take place in the plots to which lime or dolomite, plus phosphate, had been applied.

A general marked improvement in the growth of the pasture in all plots resulted from the renovation alone, and some clover did become re-established, but only in those plots which had received either lime or dolomite plus phosphate, the best treatment appearing to be dolomite plus superphosphate. The area was grazed from time to time and mowed

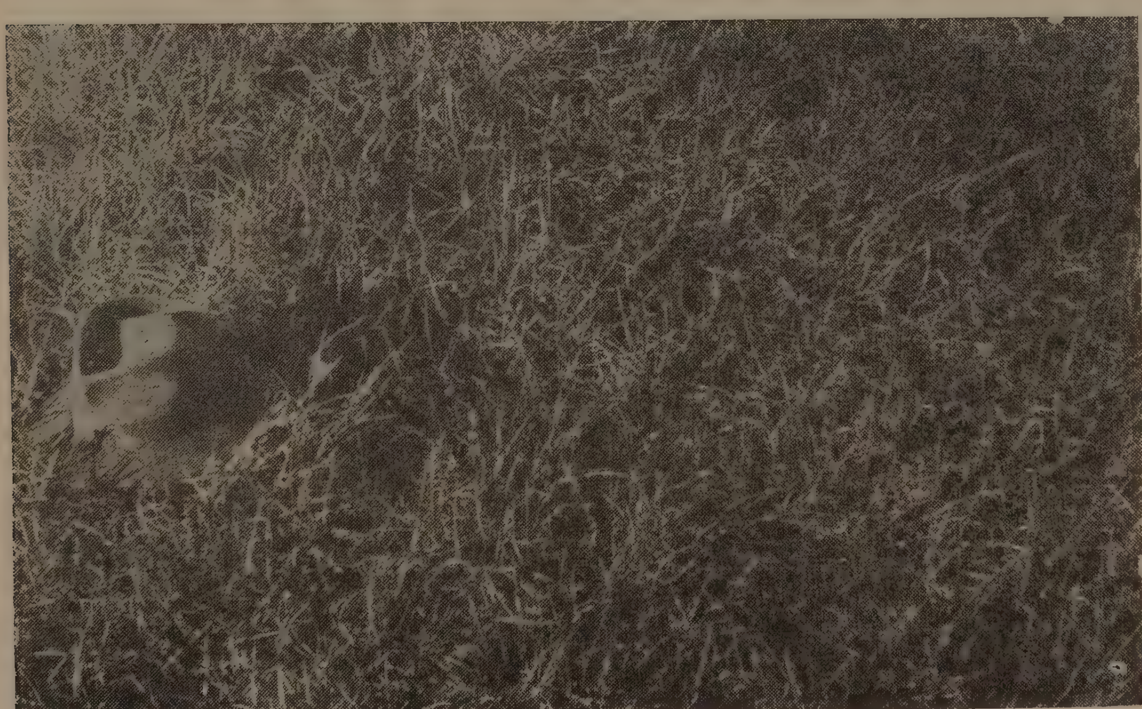


Plate 38.
Close-up of Unfertilized Plot.

Plate 39.

Close-up of a Plot Treated with Dolomite and Superphosphate.

occasionally to prevent the grass from growing rank. In order to further test the efficacy of the treatments, a strip running at right angles to the plots, and therefore covering all treatments, was again renovated in the autumn of 1948, and sown to mixed clovers.

Patches of both red and white clovers appeared throughout, but, as previously, they were confined almost entirely to the plots which had received lime or dolomite plus superphosphate.

Plates 38 and 39 show comparisons of the pasture on an untreated plot and on one which had been treated with dolomite and superphosphate. The patch of red clover on the latter plot will be noticed.

In 1950, four years later, it was reported by the owner that some clover has become established in the rock phosphate plots. This suggests that success might well be obtained by treating the pasture, after renovation, with either basic superphosphate or rock phosphate, but that interaction with the latter would seem to depend on the state of fineness of the particles. If rock phosphate alone could be used successfully it would, of course, be the most economical fertilizer to apply.

At the same time as the experiments on the pasture were being conducted, the farmer was encouraged in his work of cultivating small areas on the contour. These were first planted to cash crops, such as peas and turnips, which had been limed and fertilized according to Departmental recommendations and were then sown to mixed pasture grasses and clover. This system was found to be sound economically and the cash crops not only gave satisfactory returns but also paid handsomely for the heavy fertilization which later, as residual material, supplied the plantfood needs of the sown pasture.

Further pot experiments were also carried out with red clover with a view to comparing its composition when grown in differently fertilized soil.

The results, whilst chiefly of academic interest, do show that more magnesium has been absorbed by the plant from those pots receiving superphosphate plus dolomite than from those treated with superphosphate alone or superphosphate plus lime. This again supplies further evidence of a magnesium deficiency in these soils.

Plate 40.

Close-up of Ryegrass and Clover Pasture Grown on Cultivated Land.

Plate 41.

View of Portion of a Dairy Herd, Showing The Good Condition of the Stock After Pasture Improvement and Supplementary Feeding Had Been Practised

An inspection of the farm made in May, 1950, showed that the health of the dairy herd was good and that marked success had been obtained with cultivated and sown pastures.

Plates 40 and 41 illustrate the excellent pasture that was being grown under cultivated conditions at the time of the visit, and the sleek condition of the stock.

TUBERCULOSIS-FREE CATTLE HERDS.

(AS AT 18th JUNE, 1951.)

Breed.	Owner's Name and Address of Stud.
Aberdeen Angus ..	The Scottish Australian Company Ltd., Texas Station, Texas F. H. Hutton, " Bingegang," Dingo
A.I.S...	F. B. Sullivan, " Fermanagh," Pittsworth D. Sullivan, " Bantry " Stud, Rossvale, *via* Pittsworth W. Henschell, " Yarranvale," Yarranlea Con O'Sullivan, " Navillus Stud," Greenmount H. V. Littleton, " Wongalea Stud," Hillview, Crow's Nest J. Phillips and Sons, " Sunny View," Kingaroy Sullivan Bros. " Valera " Stud, Pittsworth Reushle Bros., " Reubydale " Stud, Ravensbourne H. F. Marquardt, " Chelmer," Wondai W. G. Marquardt, " Springlands," Wondai A. C. and C. R. Marquardt, " Cedar Valley," Wondai
Ayrshire	L. Holmes, " Benbecula," Yarranlea J. N. Scott, " Auchen Eden," Camp Mountain
Friesian	C. H. Naumann, " Yarrabine Stud," Yarraman J. F. Dudley, " Pasadena," Maleny
Jersey	W. E. O. Meier, " Kingsford Stud," Rosevale, *via* Rosewood J. S. McCarthy, " Glen Erin Jersey Stud," Greenmount J. F. Lau, " Rosallen Jersey Stud," Goombungee G. Harley, Hopewell, Childers Toowoomba Mental Hospital, Willowburn Farm Home for Boys, Westbrook F. J. Cox and Sons, " Rosel " Stud, Crawford, Kingaroy Line R. J. Browne, Hill 60, Yangan P. J. L. Bygrave, " The Craigan Farm," Aspley A. Verrall and Sons, " Coleburn Stud," Walloon R. J. Crawford, " Inverlaw Jersey Stud," Inverlaw, Kingaroy P. H. F. Gregory, " Carlton," Rosevale, *via* Rosewood E. A. Matthews, " Yarradale," Yarraman

PLEURO-PNEUMONIA INVESTIGATION.

The Division of Animal Industry of the Department has undertaken an investigation to ascertain if the present methods of control of pleuro-pneumonia can be improved and the disease eventually stamped out.

A veterinary officer now stationed at Cloncurry will work over a large territory extending into the Gulf region and down the western stock routes. He will collect information on all aspects of pleuro-pneumonia infection of paddock and travelling stock and the efficacy of quarantine and vaccination in controlling the disease.

Outbreaks of pleuro-pneumonia are the cause of considerable stock losses and dislocation of stock movements.

The Sheep Blowfly Problem in Queensland.

5. Modern Methods of Blowfly Control.

S. J. MILLER, Sheep Husbandry Officer.

AT least some of the methods which can be used to control blowfly strike are fairly well known. Woolgrowers who utilise them all to advantage realise the importance of working to a programme which anticipates the fly waves, and of taking reasonable precautionary measures to prevent strike.

Clear cut programmes for blowfly control measures must be worked out for application under various conditions—for example, spring or autumn lambing, summer or winter rainfall, &c. Many factors have to be considered. The known lines of attack, pointing out advantages and disadvantages of various methods used, the time to apply them, and when they can be best used in a co-ordinated programme, are discussed in this section.

Blowfly control measures start when the lambs are marked and these continue throughout the life of the sheep. No one method of attack is sufficient. Most graziers realise this but there are many who do not or will not realise that when more than one line of attack is used the aim is to keep ahead of the fly and anticipate a wave.

Preventive methods may be grouped under three headings:—

(*a*) Measures to reduce inherent predisposition.

(*b*) Measures to reduce immediate susceptibility.

(*c*) Treatment of strike.

I. MEASURES TO REDUCE INHERENT PREDISPOSITION.

The following methods tend to reduce conformation defects which make sheep attractive to attack by blowflies. Their effects last throughout the life of the sheep and the cost when distributed over the productive life is small in comparison with the protection afforded.

1. Docking.

Correct docking should be the first step taken by graziers to protect their sheep against fly strike. The effects of this simple operation are often marred by trying to work too quickly or by carelessness. The length at which the tail is docked affects both the occurrence of tail strike in the wound immediately after docking and the incidence of crutch and tail strike in the later life of the animal.

It has been shown in field experiments that the shorter the tail the greater the incidence of crutch strike. The most suitable length at which to cut lambs' tails appears to be about level with the tip of the vulva. Tails cut at this length grow proportionately with the rest of the body and give the greatest protection against crutch strike, as the following figures given by C.S.I.R.O. indicate:—

	Grouping According to Tail Lengths.		
	Vulva Covered.	Medium.	Short.
Number of sheep	74	69	81
Number of breech strikes ..	9	15	20
Number of breech and tail strikes	–	5	8
Number of tail strikes	1	2	7

The younger the lamb when docked and the longer the stump the more quickly the wound heals. Further, healing is hastened if the skin is pushed forward with the knife before cutting so that the severed skin slightly overlaps the bone. The quicker this wound heals the less chance there is of tail strike in recently marked lambs. The turning back of this severed skin over the end of the stump does away with the woolly tipped tail and so removes the chance of this area becoming soiled with faeces and urine and thus becoming attractive to flies.

2. The Mules Operation.

Many woolgrowers do not seem to realise that the main and most important effect of the Mules operation is to stretch the bare area under the tail. In correctly treated sheep the bare area usually measures about four inches across as against 1½ inches in untreated animals; consequently, repeated soiling of the wool-growing skin by urine is prevented and the area will not become attractive to flies. The Mules operation can give added protection from crutch strike even to plain breeched sheep, and this, of course, results entirely from the stretching of the bare area.

The technique has been described in several publications but it is one that can best be learned by demonstration, for which purpose the district Sheep and Wool Adviser of the Department should be contacted. Despite the fact that the Mules operation has given excellent results under field conditions, many woolgrowers are antagonistic to its use. These are usually men who have never tried it!

Sheep can be treated with the Mules operation at any age, but the most suitable time is after their first shearing. Should this be undesirable due to prevalence of the small black bush fly which prevents the wound from healing, it would pay to have a special crutching at a later date and apply the Mules operation immediately afterwards. Several graziers to-day are performing the operation at marking time because of labour shortages. When applied at this age the operation should be more radical, which may result in unmothering of lambs. However, the earlier protection against blowfly strike may compensate for this.

There are several indirect advantages to be derived from applying the Mules operation. These may be stated as follows:—

(1) *Easier Crutching.*—It is far easier to crutch sheep which have been treated by the Mules operation. This is an important factor both to the man who does his own crutching and to the owner who has this work done by contractors. It means better work and greater contentment amongst the shearers and there are less stained pieces.

(2) *Better Jetting and Spretting.*—While it is not usually necessary in Queensland to jet or spret sheep which have been treated by the Mules operation and which are crutched once a year, it may have to be done if it is difficult to arrange for crutchers. Should this occur, it will be found that it is a good deal easier to get even penetration of the wool by the jetting fluid. This of course means better jetting or spretting and better protection.

(3) *Reduction of Breeding Grounds.*—It has been shown conclusively that the primary fly, that is, the one which initiates the majority of strikes, breeds mainly in strike on living sheep. The Mules operation virtually robs the fly of its breeding ground and in this way it is an important direct attack on the fly population itself.

(4) *Relief from Worry.*—One of the most important indirect advantages of the Mules operation is the mental relief it affords owners and managers, who in the days before the Mules operation could never feel quite certain that there was not a bad smash just around the corner as the result of a fly wave suddenly developing. If the sheep have been subjected to the Mules operation, even the worst fly wave is unlikely to be responsible, either directly or indirectly, for heavy losses.

(5) *Improved Property Management.*—The Mules operation has an immense effect on property management. It reduces blowfly control measures to a minimum and what used to be a continuous and onerous task is now a simple job, which can be expeditiously performed. This means that more time is available for constructive work such as the erection and maintenance of improvements. This was well borne out during the war when station labour was difficult to obtain. Properties which practised the Mules operation on each year's ''drop'' of ewe weaners soon had complete flocks which had been treated. Relieved of the work usually associated with fly control, the available labour could be devoted to constructive work.

3. The Tail Strip Operation.

The Mules operation will not prevent strike originating on the tail. Docking to the recommended tail length will greatly reduce the number of tail strikes, but it will not eliminate them completely. The longer tail advocated has met with the following objections from graziers:—

(1) It is more difficult to shear or crutch cleanly.

(2) There is more risk of injury to the vulva at shearing.

(3) It increases the tendency to dagginess when the sheep scour.

(4) The presence of wool-bearing skin on the tip and underside of the tail results in soiling and strike in some sheep.

The tail strip operation has been shown to be a valuable adjunct to correct docking. It consists of removing a strip of wool-bearing skin from the upper surface of the tail so that the wound, on healing, draws

up the bare skin from the under surface of the tail to cover the sides and tip. The cut commences about two inches above the butt of the tail. This operation is preferably done on its own at marking time but may be performed in conjunction with the Mules operation at marking or weaning.

II. MEASURES TO REDUCE IMMEDIATE SUSCEPTIBILITY.

Important measures can be adopted to provide temporary protection against strike. Their adoption is governed to a large extent by local conditions, available labour and plant, husbandry methods practised and a knowledge of when the main fly waves are likely to occur. They are used, too, in anticipation of fly waves.

It is unsound practice to depend entirely on the measures described in this section for the control of fly strike in a flock. In nearly all cases they are to be regarded as supplementary to the measures outlined in the preceding section in order to keep ahead of the seasonal fly waves.

1. Shearing.

Shearing is probably the most efficient method yet known of reducing susceptibility to fly strike. Two main waves of blowfly activity can be expected, one in autumn (April-May) and the other in spring (September-October-November). Shearing just prior to, or at the beginning of, what is normally the worst fly season of the year will usually give a good deal of protection, and may even completely tide the sheep over that particular fly wave. If fly strike commences earlier than expected and shearing is in progress during a wave, there may be trouble from strike in cuts. Sheep that have been previously subjected to the Mules operation are less likely to be injured. It is not possible for all wool growers to shear just prior to the worst fly period, as factors such as availability of shearers, lambing dates, grass seed occurrence, and seasonal conditions have to be considered. However, shearing dates should be selected to meet each combination of circumstances. If shearing can be done prior to one fly wave, the mid-season crutching will precede the next and mating, lambing and marking can be arranged.

2. Crutching.

Crutching is the measure most commonly adopted for the prevention of breech strike. One crutching at or near mid-season is valuable not only by conferring protection but also by preventing the occurrence of excessively dirty wool. The protection given against breech strike usually lasts for about six weeks. Sheep which have been treated with Mules operation are easier to crutch and the finished job is more satisfactory.

It is frequently necessary to shear the wool away from the prepuce of rams and wethers to prevent soiling and consequently fly strike. This is known as ringing and is done while crutching.

In normal years, correct docking, the application of the Mules operation, and shearing and crutching at the right times will reduce losses due to fly strike to a minimum. The important things are:—

(*a*) *to do these things;*

(*b*) *to do them efficiently;*

(*c*) *to do them at the right times.*

Anticipate fly trouble—don't wait for it.

3. Jetting.

Jetting is used as a preventive against fly strike. It consists essentially of forcing a jet of water containing a maggot poison in suspension or in solution into the fleece so as to saturate areas susceptible to fly strike. The success of the method depends on attention to essential details and especially to the early treatment of flocks when fly activity begins. Its main use should be in an emergency, such as when local conditions prevent shearing or the mid-season crutching and a wave is expected or has actually started. Another time when it will be necessary to jet will occur if the expected fly wave commences later than anticipated, and the advantages sought by shearing or crutching are no longer effective. Thus, as a control measure against breech strike, it is an emergency weapon and a good one. Jetting can be done at short notice using labour and materials already on the place.

Jetting is most commonly used for protection against crutch and tail strike in ewes, but it can also be applied to the breech and head of rams, and the breech and belly of wethers. With the advent of the newer insecticides, it has also given promise against body strike.

The fluid used contains either a maggot poison such as arsenic or BHC, or a substance such as DDT, which prevents flies from laying eggs on the treated wool. Of the older jetting fluids, calcium arsenite is the most protective and also one of the cheapest of the materials available. It has been recommended for general use, because it is considered that the extra period of practical protection which it affords against strike (4-5 weeks as compared with about three weeks from sodium arsenite) more than compensates for some difficulty in its preparation and management. (Calcium arsenite drops out of suspension unless the jetter tank has an agitator working in it.)

Sodium arsenite provides a cheap mixture which is relatively simple to prepare and which does not require the fitting of an agitator to the machine. It may be used for all jetting on small properties where an extra treatment during a fly wave is unimportant because of easy mustering.

There are a number of points about jetting which call for comment.

(1) *Multijet Nozzles.*—The number and size of jets that may be used depend on the capacity of the plant available. Fluctuations in pressure as the cut-off is opened should not exceed about 15 lb. up or down when jetting at 80 lb. per square inch. Jetting should be done at the lowest pressure at which the fleece can be quickly wet to the skin. Crutch wool is especially difficult to jet as the sheep may crouch and then the staple is nearly vertical. Because of this it is necessary to jet upwards onto the crutch and downwards over the tail. It is often wise to mix a colour (1 lb. red oxide to 100 gallons) with the mixture to see if complete penetration is attained.

Many people jet safely at 120-150 lb. pressure, but it is advisable to use a small nozzle (3/64 inch), and hold it about 12 inches from the fleece. Larger plants are capable of working a 5-jet nozzle, each having a bore of 1/16 inch or 5/64 inch. This delivers nearly four gallons of liquid per minute at 80 lb. per square inch, necessitating the re-use of fluid which runs off. With the smallest power jetting plants, one 3-jet nozzle (1/16 inch bore) may be used.

To prevent blockages, a sieve fine enough to protect the nozzle and fitted at the outlet from the jetter tank is essential. A sieve of 24 mesh to the inch at the outlet will prevent nearly all blockages in 1/16 inch nozzles but it is hardly fine enough for 3/64 inch nozzles.

(2) *Re-using Jetting Fluids.*—If the largest nozzles are fitted, arrangements should be made to return to the jetter tank the liquid that splashes from the sheep, in order to avoid waste of mixture, excessive requirement of water, and the accumulation of poison in the vicinity of the yards. If calcium arsenite is being re-used, new full strength mixture must be continually added to maintain the strength and to avoid progressive lowering of the arsenic content of the fluid as the result of the deposition of arsenic in the wool. About 100 gallons of the new mixture is added after the treatment of each 400-600 sheep.

(3) *Jetting Injuries.*—Jetting injuries can cause serious loss. They usually result from forcing the fluid through the sheep's skin. Accurate control over the operation is obtained by holding the nozzle 2-3 inches from the wool, reducing the pressure to the lowest at which the fleece can be wetted to the skin, and compensating for lost speed of delivery by using larger or multijet nozzles. The policy of economical blowfly control by jetting involves the jetting of many small strikes. To jet seriously struck sheep with arsenic is dangerous. However, BHC can be used. If arsenic is being used it is advisable to refrain from jetting and to substitute dressing for strikes which are more than three inches across. The smallest strikes can be jetted as if they did not exist, and strikes of intermediate or doubtful size can be treated at reduced pressure, by drawing back the nozzle while jetting the surrounding fleece at normal pressure.

(4) *Special Considerations.*—There are a number of difficulties to be overcome or objections to be met if a jetting programme is to be used. Under Queensland conditions jetting to prevent crutch strike should be used as an emergency in conjunction with the methods already discussed.

(*a*) *Lambing.*—The normal lambing period occupies about six weeks. Jetting applied a week before lambing begins will not protect the most susceptible ewes from crutch strike until lambmarking.

(*b*) *Mating.*—The fear is sometimes expressed that a thorough jetting programme may interfere with mating. Experiments, however, failed to show that any disadvantage resulted from jetting ewes prior to mating.

(*c*) *Small strikes.*—No jetting methods have succeeded in preventing all strikes for more than two weeks. For a further 2-3 weeks the increase in size in individual strikes is greatly delayed. Nevertheless the small strikes, up to two inches in diameter, may be numerous in a jetted flock, and their presence causes many graziers to condemn jetting or to expend unnecessary effort in dressing the few sheep that are struck.

(5) *Jetting with DDT and BHC.*—Recently, work has been done to determine the value of DDT and BHC for control of crutch strike. BHC is a maggot poison but will not last long in the fleece. DDT has a greater residual effect and prevents flies depositing eggs.

The advantages of these materials over arsenic may be stated as follows:—

(1) DDT and BHC both kill flies and hence reduce the fly population.

(2) DDT and BHC are much easier to handle.

(3) Jetting injuries are less likely to occur.

(4) BHC can be used on struck sheep without fear of harmful effects.

On the other hand, DDT is not a good maggot poison and is very costly when used to jet struck sheep.

Consequently, BHC is better to use once a fly wave has commenced. In a well organised control programme, where the aim is to keep ahead of the fly, arsenic is equally effective except for the fact that DDT and BHC help to reduce fly numbers and are not harmful to struck sheep.

4. Protection of Rams' Heads.

Head strike in rams is due to the rapid multiplication of bacteria in the excretions in the skin creases about the poll and base of the horns. It may also follow infection of wounds from fighting. The methods used to control head strike are as follows:—

(1) *Shearing.*—Shearing rams twice yearly will prove beneficial, especially if it can be done in spring and autumn before the fly waves.

(2) *Swabbing.*—The maggot poison or fly repellant can be worked well in around the base of the horns. Arsenic, BHC or DDT could be used in this way, but the method is very time-consuming.

(3) *Dry Dressings.*—For this purpose dry boracic acid powder worked in thoroughly at the base of the horns is of value.

(4) *Jetting.*—This is probably the best method to use provided it is applied at the correct time. Arsenic has been used successfully, though there is some danger of rendering the rams infertile. Jetting must be done carefully to avoid splashing and a pressure of 30-50 lb. is sufficient.

Preliminary trials indicate that jetting the poll and adjacent parts with DDT or BHC preparations may give protection for up to six weeks. About one-third to one-half gallon should be used so that the wool is thoroughly saturated. Preparations containing 1 per cent. BHC or 2 per cent. DDT have proved successful and are to be preferred to arsenic if the rams are being treated prior to joining.

5. Protection from Body Strike.

Flies are attracted to areas where bacteria are active in the fleece. This condition is usually referred to as fleece rot. It is most prevalent in wet seasons and young sheep are much more likely to be affected. The obvious first line of attack is to shear the sheep if possible. However, this is not always practicable and other methods must be employed. Treatment of sheep with DDT or BHC preparations offers some promise for the control of body strike. Application may be by either spraying or dipping.

A light spray of DDT can be applied from the top spray of a shower dip. Alternatively, a jetting plant, to which is attached a special spraying device, can be used. The rose of a garden hose, or a series of fish tail, "Rega" cyclone, or Roseberry patent nozzles fitted to a curved spray boom, which is bent to fit over the back and shoulder of an average sheep, facilitate the work. The jetting plant is run at a pressure of about 150 lb. per square inch.

BHC can be applied from the top of a shower dip or from a jetting plant with the usual or specially adapted nozzles.

A 1 per cent. solution of DDT or 0·05 to 0·075 per cent. solution of BHC is used. Amounts used vary from a quarter to half a gallon per sheep, depending on wool length.

The materials have been applied to an area extending from behind the neck, in front of the shoulders, to the tip of the tail, and well down both sides and flanks of the sheep. In practice the DDT solution is applied till run-off just commences. The re-use of any DDT collected on the floor is not recommended. The re-use of BHC is only recommended where large quantities (up to two gallons) are used for jetting struck sheep through wide bore (up to 5/64th inch) nozzles.

If plunge dipping is undertaken the sheep should be passed through a swim dip containing DDT or BHC at not less than four times dipping strength recommended to control body lice. This method is usually practised if spraying fails during a severe fly wave. It is very costly, especially if the sheep are full woolled.

Spraying or dipping with DDT or BHC will prevent body strike or reduce it to a very low level for a few weeks. Spraying in advance is particularly useful when heavy rains are expected and in areas where it is difficult to muster and treat sheep. For this purpose DDT is preferable. Waves of body strike usually last for 2–4 weeks and spraying with DDT should protect sheep for that period. DDT is ineffective against blowfly maggots and if sheep are not sprayed until body strike is detected, treatment with BHC is preferred. It will not confer such a long period of protection against adult flies as DDT, but it rapidly destroys all maggots.

Tentative recommendations for using these newer insecticides are therefore:—

(1) Use 1 per cent. DDT when spraying sheep in anticipation of a wave of body strike.

(2) Use ·05 per cent. BHC generously when treating sheep after a wave has developed. This can be used as a jetting fluid to treat struck sheep, without shearing the wool away to expose maggots.

A recent report by the Joint Blowfly Committee stated:—

> "When tested under rigorous artificial conditions 'fogging' with 10 per cent. DDT or 2 per cent. BHC gave no protection against body strike on the nineteenth day. No earlier tests were made. In a controlled field trial 'fogged' sheep were struck within three (3) days and there was no significant difference in the number of strikes on treated and untreated sheep during the three weeks following exposure."

III. TREATMENT OF STRIKE.

Blowfly strike may be defined as the condition produced by the development of blowfly maggots on the living sheep. In treating the condition it is necessary:—

(1) to remove the maggots with as little damage as possible to the sheep's tissues;

(2) to encourage healing;

(3) to kill maggots;

(4) to protect against restrike.

Some strikes will occur in spite of preventive measures. Therefore when flies are active, frequent, careful inspection of the flock is necessary for two reasons:—(1) the sooner strikes are detected the less harm they do and the more easily and quickly they heal; (2) early detection and treatment of strikes retards the rate at which fly populations increase. Because of the latter, the maggots in the wool should be destroyed after having been clipped from the struck area if possible. No known dressing will protect a sheep which constantly soils its crutch or breech with urine. The obvious course is not to seek some "super dressing" but to apply the Mules operation. Treatment of struck sheep, after all, is the last line of defence.

In crutch strike of plain breeched sheep or of sheep on which the Mules operation has been performed, and in pizzle strike and body strike, the removal of the wool and the destruction of the maggots enable the struck area to dry out and very little more is required for satisfactory healing. The simplest dressings are sufficient under these conditions, as, for example, carbolic dip or 5 per cent. bluestone ($\frac{1}{2}$ lb. per gallon).

In more deeply seated strikes and in horn strikes where the struck area cannot be fully exposed by shearing, a liquid dressing with good penetrating qualities is required. During the last decade C.S.I.R.O. has released formulae for three dressings, all of which are effective. They are known as CBE, BTB, and BKB.

The incorporation of DDT, and to a lesser extent BHC, in blowfly dressings has the advantage that flies alighting on the dressed areas are likely to be killed and hence each treated sheep becomes, in a sense, a poison bait.

If (through the severity of the fly wave, or failure to adopt preventive measures) strikes are too numerous for available labour to deal with each of them properly, jet the struck area and two inches around it with ·05–0·1 per cent. BHC. This is a powerful maggot killer and treatment will hold the position temporarily. Mark these sheep and go over them again as soon as possible; shear off the struck areas and apply fresh dressings to any which have not dried out.

In instances where hundreds of sheep were affected with body strike, the struck animals were shower dipped with 0·05–0·1 per cent. BHC, $\frac{1}{2}$–1 gallon per head being used. This cleaned up the majority of the strikes completely.

One cannot overstress the fact that a "super dressing" is not the answer to the blowfly problem. The aim is to apply other known and proved methods of control efficiently so as to obviate as much as possible the use of dressings.

CONCLUSIONS.

The blowfly is such a major cause of decreased production in the sheep industry that husbandry methods need to be arranged to allow an efficient control programme to be put into action without interfering with other aspects such as mating, lambing, &c. Because of this no general calendar programme can be given to cover the State or even a district.

The best control programme commences early in the sheep's life by carrying out procedures which will reduce the animal's susceptibility to strike throughout its life. These are—

(1) correct docking;
(2) Mules operation;
(3) tail strip operation.

After having made the sheep less attractive to the fly, certain procedures must be carried out to keep ahead of the seasonal fly waves. It is known that these occur in the autumn and the late spring. In any programme of work designed to prevent fly strike, shearing and crutching play an essential part. If possible, these should be arranged so as to precede the fly waves. If the fly wave is earlier or later than expected, or shearing cannot be arranged for various reasons, such as the occurrence of grass seed, shortage of labour, &c., jetting is necessary.

However, correct docking, Mules operation, shearing and a mid-season crutching will keep the fly under reasonable control in most years. Jetting is an added weapon to meet unusual circumstances.

Modern insecticides such as DDT and BHC each play an important part in the control of head strike and body strike. BHC can also be used to advantage to check heavy strike conditions if the numbers affected become too great to dress.

Some strike will occur regardless of preventive measures, but the aim should always be to act before the fly and so keep strike numbers to a minimum.

ASTRONOMICAL DATA FOR QUEENSLAND.

AUGUST.

Supplied by W. J. Newell, Hon. Secretary of the Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			MINUTES LATER THAN BRISBANE AT OTHER PLACES.					
Day.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	6·30	5·18	Cairns	17	41	Longreach	29	40
6	6·27	5·21	Charleville ..	26	28	Quilpie	36	34
11	6·23	5·23	Cloncurry	41	58	Rockhampton ..	4	16
16	6·19	5·26	Cunnamulla ..	30	28	Roma	16	18
21	6·14	5·28	Dirranbandi ..	21	17	Townsville ..	15	35
26	6·10	5·31	Emerald	14	24	Winton	33	47
31	6·04	5·33	Hughenden ..	26	44	Warwick	5	3

TIMES OF MOONRISE AND MOONSET.

At Brisbane.

Day.	Rise.	Set.
	a.m.	p.m.
1	5·19	3·38
2	6·01	4·35
3	6·39	5·32
4	7·13	6·28
5	7·44	7·24
6	8·13	8·20
7	8·42	9·16
8	9·12	10·14
9	9·45	11·16
10	10·21	..
		a.m.
11	11·04	12·21
12	11·55	1·28
	p.m.	
13	12·55	2·36
14	2·02	3·41
15	3·14	4·40
16	4·25	5·31
17	5·34	6·14
18	6·40	6·52
19	7·42	7·26
20	8·43	7·58
21	9·42	8·30
22	10·40	9·02
23	11·38	9·37
24	..	10·14
	a.m.	
25	12·37	10·57
26	1·33	11·43
		p.m.
27	2·26	12·35
28	3·15	1·30
29	3·58	2·26
30	4·38	3·24
31	5·14	4·21

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

Charleville 27; Cunnamulla 29; Dirranbandi 19; Quilpie 35; Roma 17; Warwick 4.

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Day.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	9	30	25	44	0	20	26	53
6	17	19	33	36	8	10	37	41
11	29	12	44	26	19	1	52	29
16	27	12	43	26	18	1	50	29
21	13	23	28	39	2	14	31	44
26	9	30	25	45	0	21	26	54
31	13	25	28	41	3	16	31	48

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	3	53	34	66	18	51	4	44
3	10	46	37	61	22	47	9	38
5	20	36	43	55	28	40	17	31
7	30	24	51	46	35	32	25	21
9	42	13	58	39	43	24	35	13
11	52	8	66	36	50	21	43	8
13	56	2	68	32	52	17	46	3
15	53	4	67	33	50	19	44	5
17	42	13	58	39	43	24	35	13
19	29	32	50	53	35	38	25	28
21	18	37	42	56	27	41	16	32
23	8	47	36	62	21	47	8	39
25	5	55	35	67	19	52	5	45
27	2	56	33	67	17	53	3	46
29	5	51	35	64	19	50	5	43
31	13	43	39	59	24	45	12	36

Phases of the Moon.—New Moon, 3rd August, 8.39 a.m.; First Quarter, 10th August, 10.22 p.m.; Full Moon, 17th August, 12.59 p.m.; Last Quarter, 24th August, 8.20 p.m.

On 15th August the sun will rise about 15 degrees north of true east and set the same amount north of true west, and on the 7th and 19th the moon will rise and set very close to true east and true west respectively.

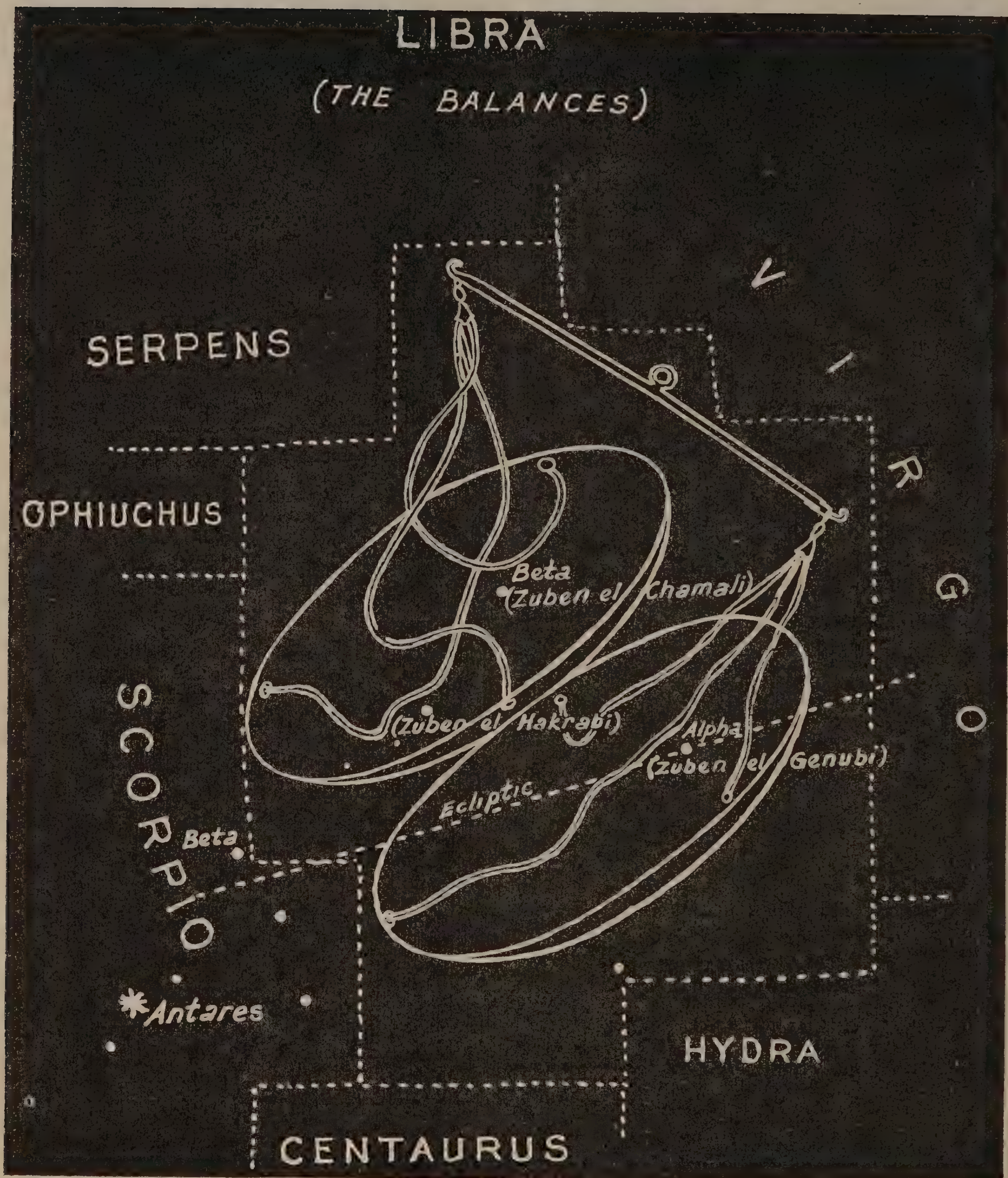
Mercury.—An evening object all this month, not far from Venus but much fainter and near to the sun. At the beginning of the month, in the constellation of Leo, will set over 2 hours after the sun and will reach greatest angle from the sun on the 3rd. By the end of the month it will be in line with the sun.

Venus.—Now passing out of the evening sky. On the 1st it will set about 3 hours after the sun and by the 31st will set only ½ hour after sunset.

Mars.—In the constellation of Gemini, should now be easily seen low in the eastern morning sky, when it will rise about 1 hour before the sun at the beginning of August and about 1½ hours before the sun at the end of the month.

Jupiter.—Now a brilliant object in the eastern sky during the early part of the night; rising between 10 p.m. and 11.15 p.m. at the beginning of the month and between 8 p.m. and 9.15 p.m. at the end of the month.

Saturn.—In the constellation of Virgo, will set between 9 p.m. and 10.15 p.m. at the beginning of August and at the end of the month only 2 hours after sunset. It is higher in the sky than Mercury and Venus but fainter.



THE CONSTELLATIONS.

LIBRA AND SEXTANS.

Between the constellations of Virgo (described in the May Journal) and Scorpio (described in the July Journal last year) lies the constellation of Libra; represented by the scales or balances. It is not a particularly bright group, having only one star of 2nd magnitude and two of 3rd magnitude among the number of fainter stars. It is well known as one of the "Signs of the Zodiac," the sun passing through it from 1st to 25th of November. Alpha, which is a double star, lies almost on the ecliptic and a line from Antares (Alpha Scorpii) points to Beta Librae, which is a 3rd magnitude green star and an exception to the rule that green stars are faint and generally small companions of binaries (binaries are groups of two or more stars moving about a common centre of gravity). In this constellation is another example of Beta, this being brighter than Alpha.

Serpens (The Serpent).—This is also a group of rather inconspicuous stars, the brightest being of 2nd magnitude. However, it contains several interesting telescopic objects, including M5, a fine globular cluster, and many doubles and variables.

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DEPARTMENT OF AGRICULTURE

AUDAX AT FIDELIS

QUEENSLAND AGRICULTURAL JOURNAL

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LEADING FEATURES

Cattle Drafting Yards
Horticulture in Central Queensland
Salmonellosis in Rams
Salad Vegetables
Dry Farming Practices
Grass Tetany

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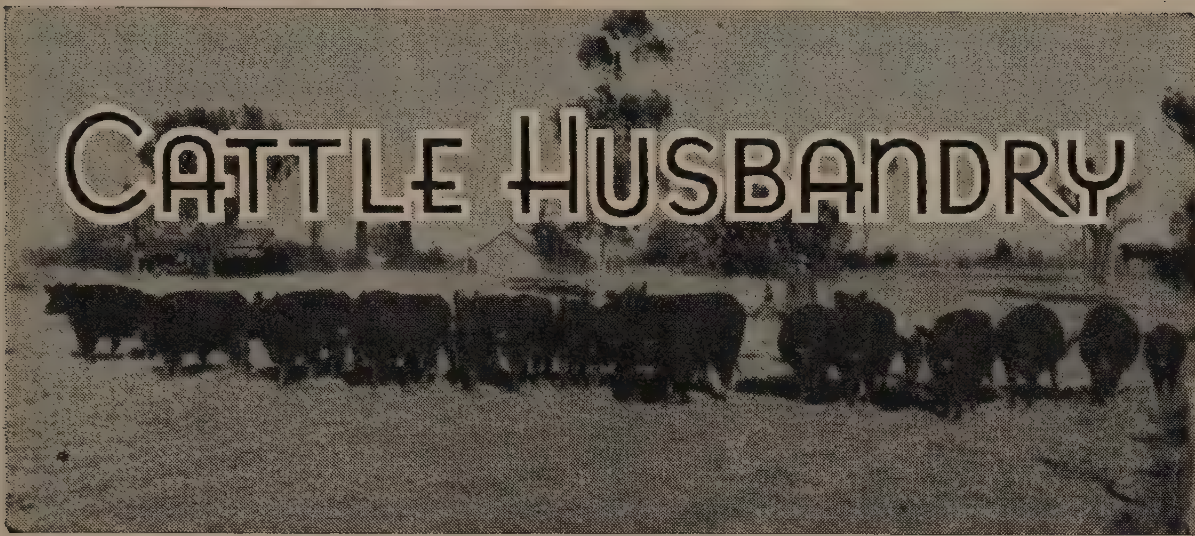

Cattle Drafting Yards.

R. H. BARTLAM, Cattle Husbandry Branch.

A SET of yards capable of handling the cattle on any property is essential and it is wise to give some thought to the problem before commencing to build.

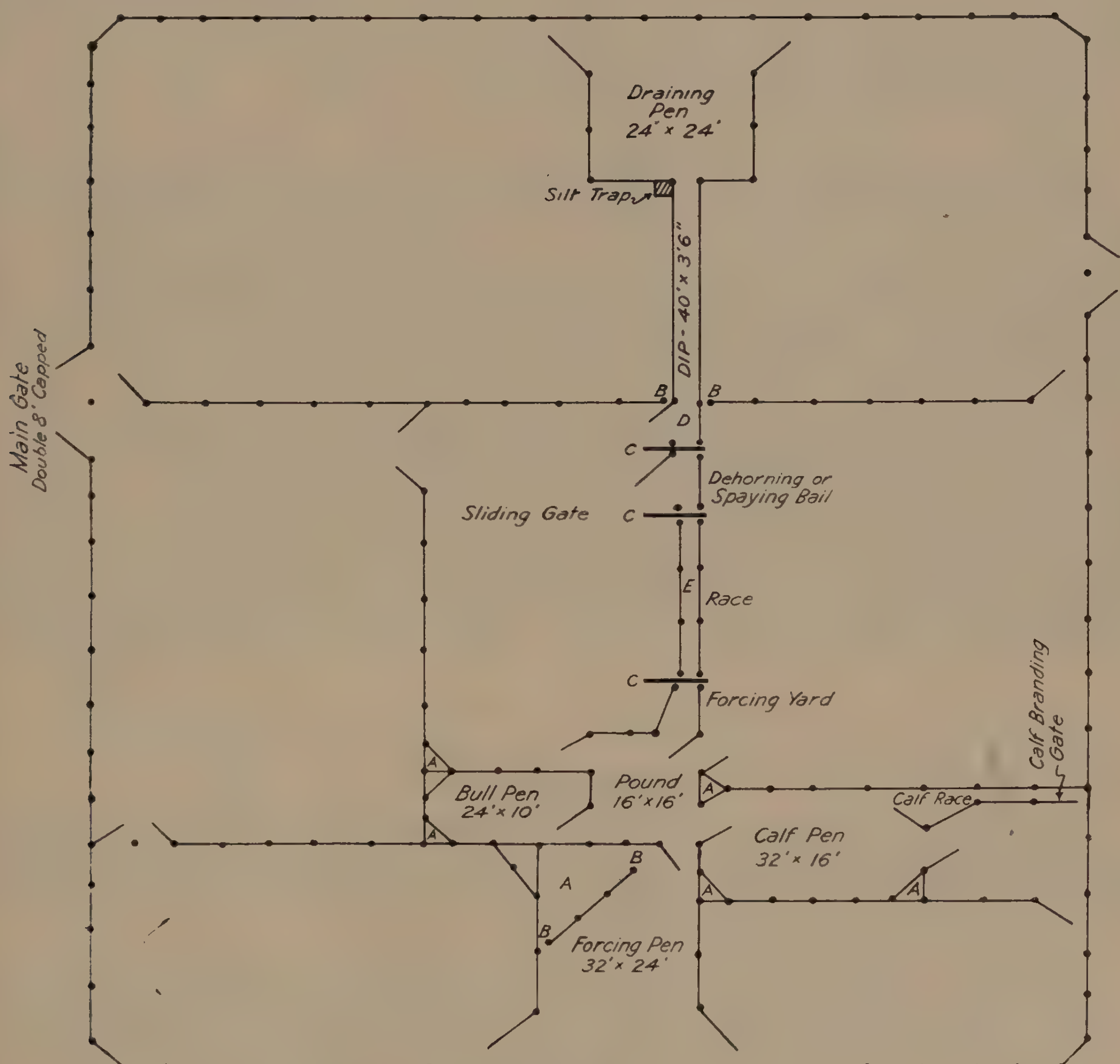

Plate 42.

Plan of Cattle Drafting Yards.—A, corners for shade trees; B, spaces for slipping through when working yard; C, slide gates; D, cemented apron; E, race or crush 22–24 in. wide. Panels are 8 ft. and 6 ft., as shown by the dots, which represent posts.

Drafting yards built in such a way as to enable all the work to be carried out with a minimum of effort must differ in some respects in individual cases, but a good basis on which to work is shown in Plate 42.

THE SITE.

The site is important and when choosing a spot for a cattle drafting yard care should be taken to avoid those things which make yarding of cattle and working them in the yard difficult. An obvious precaution is to see that the ground itself is firm and well drained. Some types of stony ridge are ideal, but areas with big stones embedded in scattered positions should be avoided. The earth soon works away from such stones with movement of cattle and the result is a loose stony surface.

Usually a yard, particularly one which is intended for dipping, is built near a creek or river so that water is easily available. Cattle react differently to river approaches and it would be wise to check carefully how the particular stock which will be using the yards behave when worked near the river. Most cattle baulk at "yarding into the river," particularly near sundown, so it may be better to have the main gates on the side nearest the river or creek, leaving plenty of room to check any tendency on the part of the cattle in hand to "ring up" as they are brought between watercourse and yard.

Shade is essential for cattle standing in the yard during the heat of the day and too much emphasis cannot be laid on the necessity for this during the summer months. It is not always possible to avoid handling cattle during hot weather; heated cattle do not work well and a few hours distress in a yard exposed to a blazing sun can mean loss of condition as well as actual danger of overheating. A few trees in appropriate places save a lot of planting later.

It will be readily understood that the constant working of stock is likely to cause erosion if the incline on which the yard is built is too steep, and anything beyond a very slight fall should be avoided. On the other hand, yards should not be placed in hollows. Dust in dry times becomes mud when it rains and any surface which cuts up under the hooves of the cattle is unsuitable. This applies to ant-hill country and some types of country covered with gum-topped box.

YARDS.

While there are changes which might be made in the plan submitted to suit individual requirements, there are several features which should be retained in any modification.

Firstly, there are two gateways shown in the outer fence of the yards—one for yarding up and one for letting go. The reason for this is that cattle using a yard regularly develop habits both good and bad, and the practice of working always in the one direction pays dividends even with the quietest of cattle and certainly with fresh bush cattle.

In the plan advocated the cattle work towards the letting-go gate and this makes for ease of future yarding up and working in the yard.

Secondly, it will be noticed that the plan provides for cattle, once they get to the forcing pen, to have one straight side to work up right through the pound, race and dip. Cattle working in such a way run better.

Thirdly, whenever possible the corners have been taken off, and the usual 8 feet panel reduced to 6 feet both to allow for the cut-off panel and to strengthen the corner. This makes it much easier for weaker cattle, particularly calves, which may get jammed in corners. Shade trees should be planted in the corners thus provided.

The calf pen, which opens from the pound, is provided with a small race and a branding "machine" is placed at the end.

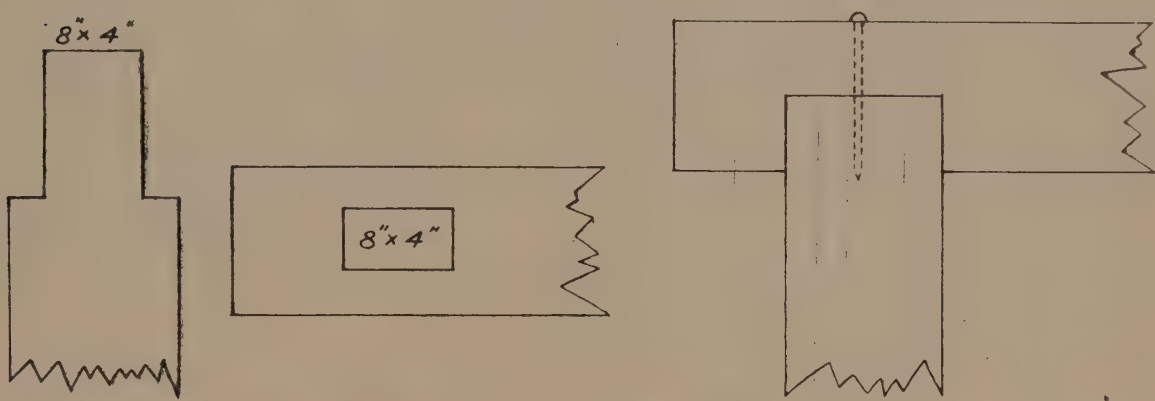

Plate 43.

Two Methods of Fitting Gatepost Caps.—Left, mortise and tenon; right, joggle fitting.

When planning for gates it is a good idea to provide overhead caps for the gateposts wherever possible and for the crush. Where yards are small, as in the pound, these could be omitted. The cap could be fitted in either of the ways shown in Plate 43, that on the left being the stronger job. That shown on the right is the quicker way and is done merely by cutting a joggle in the cap to fit the slightly squared end of the post and spiking from the top of the cap into the top of the post. The other method provides for a tenon, say 8 inches by 5 inches, in the top of the post and a corresponding mortise in the cap, pinning with an inch dowel or a half-inch bolt. Leave at least 18 inches of overhang in the cap.

The running posts should be at least three feet in the ground, and gate, crush and corner posts four feet. Where timber with some sap is used for posts, it is wise to trim off the sap from that part of the post which will be underground, and apply to this a good coat of hot coal tar. Apart from preserving the wood itself, this method eliminates the possibility of an inch or two thickness of sap rotting away early in the life of the yard and leaving posts which are loose in the ground. In heavy black soil which is inclined to "move" between the extremes of wet and dry seasons, it is a sensible precaution to have the holes dug six inches deeper and set the posts on six inches of sand as a buffer.

Gate and corner posts should be at least 14 inches in diameter at the small end, free of sap, and running posts 12 inches. To allow for sufficient head room the crush posts should be at least eight feet out of the ground and provided with a cap as support. The running

posts should be 5 ft. 6 in. out of the ground with the top rail lying flush with the top of the post. The gatepost should be sufficiently high, say nine feet, to allow a horseman to ride under the cap without having to do more than bend his neck.

Gates may be hung in several ways, and where bush timber is used for making gates the simplest form is to extend the gate upright to the cap as in Plate 44, passing the rounded end through a hole made for it. The base is also suitably rounded off, leaving plenty of shoulder in the gate upright and set into a block which is securely imbedded in the ground at the foot of the gatepost. This makes a very strong job but has the disadvantage that should the gatepost lean slightly no

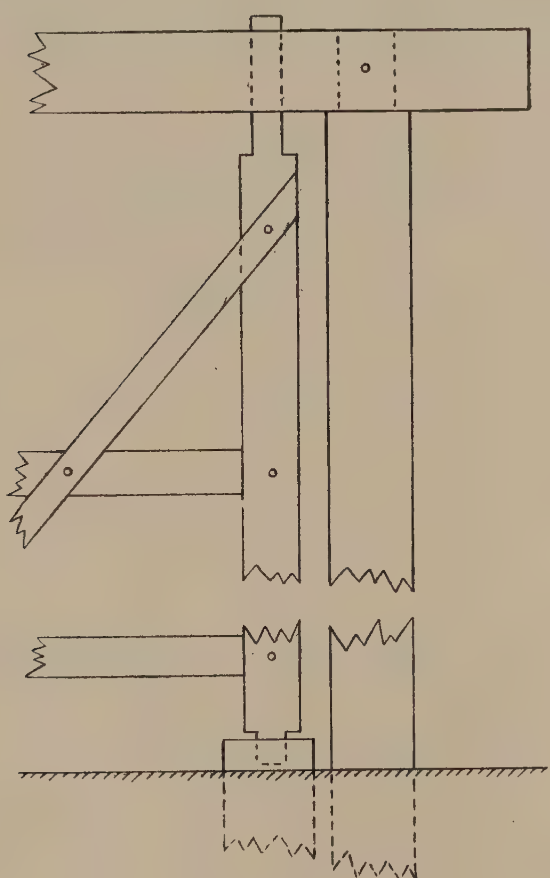

Plate 44.

A Method of Hanging a Gate.

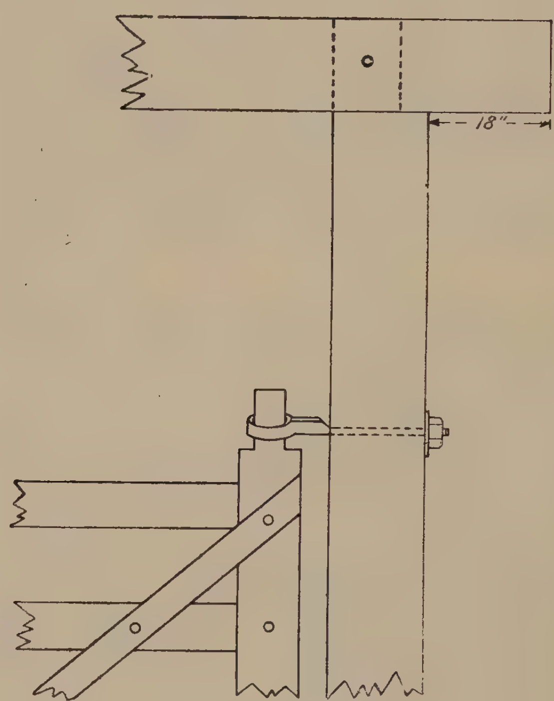

Plate 45.

Gate Swung From an Eyebolt.

adjustment can be made without straightening the post, which is often a fairly big job. A modification is shown in Plate 45. Here the gate upright, while set into a block as before, has the top cut off and set in an eye bolt which is used to secure the gate to the gate post. If the gate is not set too close to the gate post, an adjustment to the eye bolt will bring up the head of the gate should it drag through leaning of the gate post.

A simple hinge as shown in Plate 46 is sufficient where sawn timber is used for gates. Have chains secured to gate posts on all gates in such a way that the ends may be picked up to pass around the gate head with a minimum of trouble. Fumbling for chains accounts for a lot of wasted time in the work in a yard and makeshifts such as wire fastenings have a habit of coming apart under pressure at the most awkward times, causing boxing of drafts and subsequent redrafting with unnecessary handling of stock.

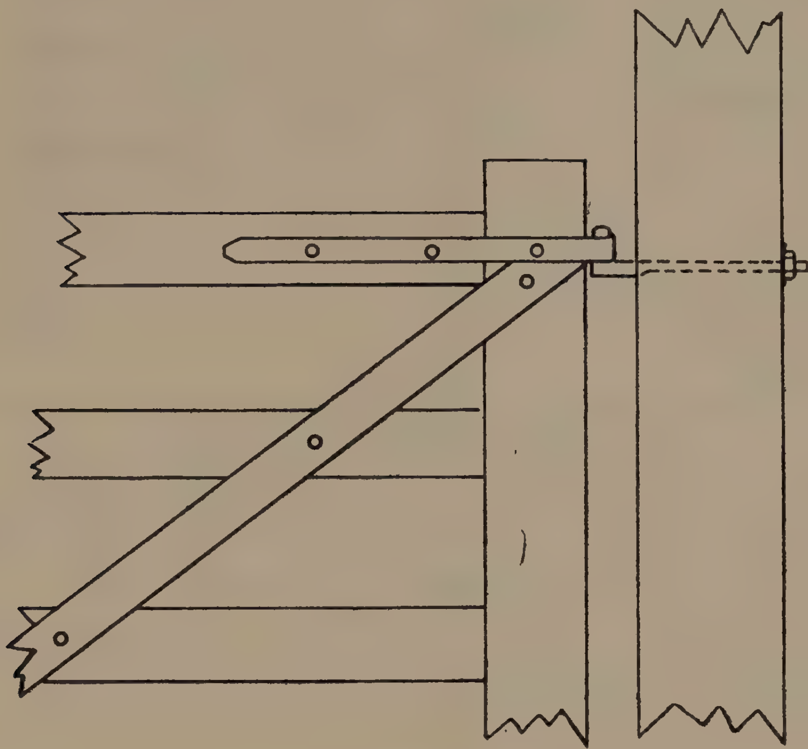

Plate 46.

Sawn Timber Gate Swung on a Simple Hinge.

Rails should not be less than four inches at the small end and free of sap. Where it is possible to get good 16-foot rails they could be used to straddle two panels at once. They should be arranged so that joins are staggered to avoid having two such rails meeting immediately above or below another. This method, shown in Plate 47, greatly strengthens a yard, but care should be taken that in the effort to get long rails, timber with too much sap at the thin end is not used. Sappy timber is the cause of much quick deterioration of yards.

The method of mortising the posts and letting the rails into them is a good one, but presents difficulties when replacements are necessary. Joggling of posts and letting the rails in flush with the inside of the posts makes a workmanlike job. The rails are tied on with double

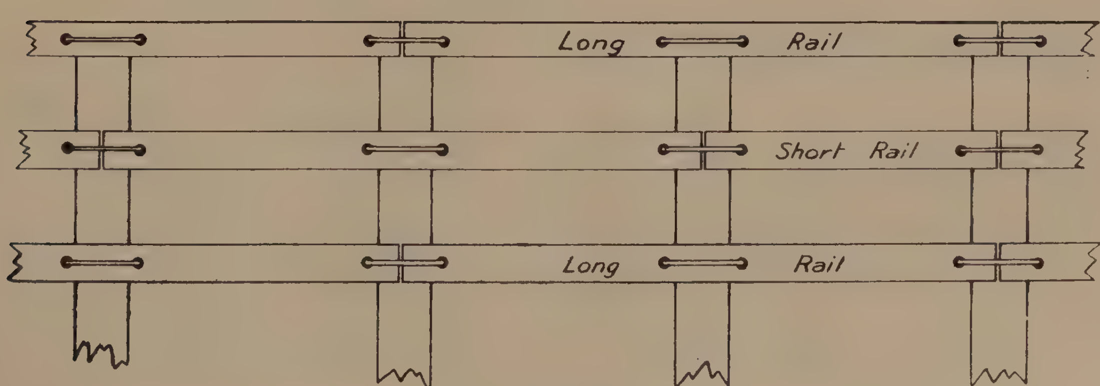

Plate 47.

Staggering of Rails to Strengthen the Yard.

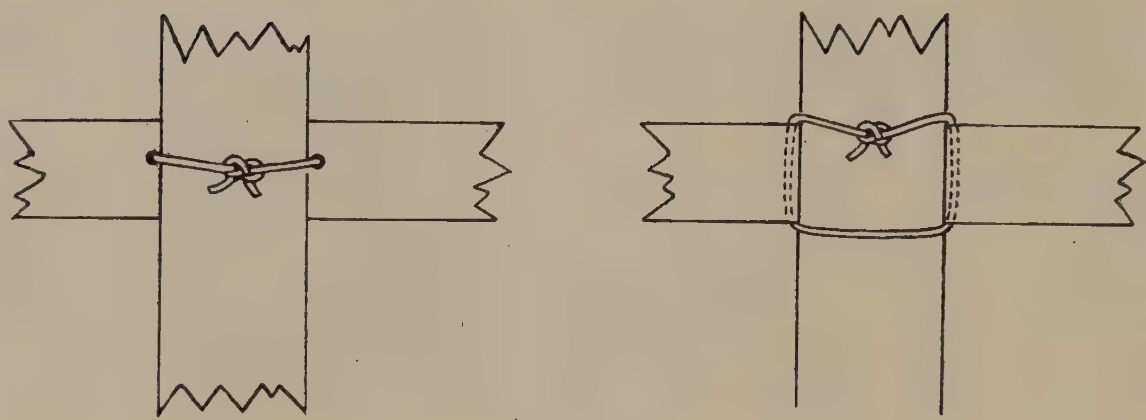

Plate 48.

Method of Tying Rails Let in Flush With the Inside Face of the Post.—Left, rail bored; right, rail not bored.

No. 8 wire and a "Cobb & Co." twitch at the back of the post (Plate 48, left). Where timbers such as lancewood and gidyea are used there is a tendency for them to split when the ends are bored for the wire, so a method which does not involve boring is employed. A longer piece of wire is needed and this, bent double, is brought from the back of the post, each end passing around an end of a rail from underneath and back to twitch at the rear of the post, as in Plate 48 (right).

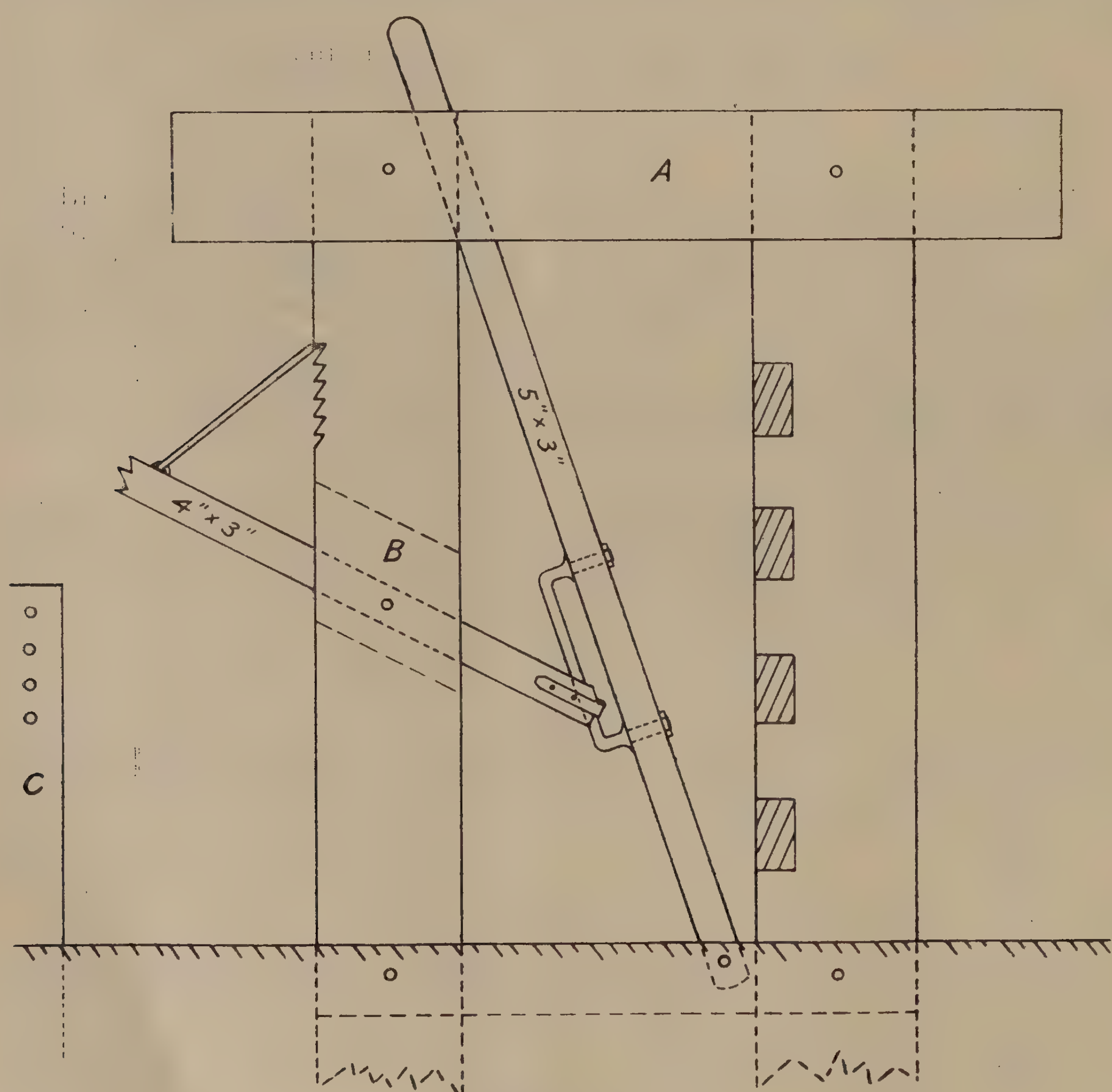

Plate 49.

Sketch of Dehorning or Speying Bail, Looking Through Race.—A, two 6 ft. long 8 in x $1\frac{1}{4}$ in. boards bolted to form a $3\frac{1}{4}$ in. channel for the sword; B, slot 18 in. x $3\frac{1}{4}$ in.; C, post to hold the handle rigid by means of a bolt.

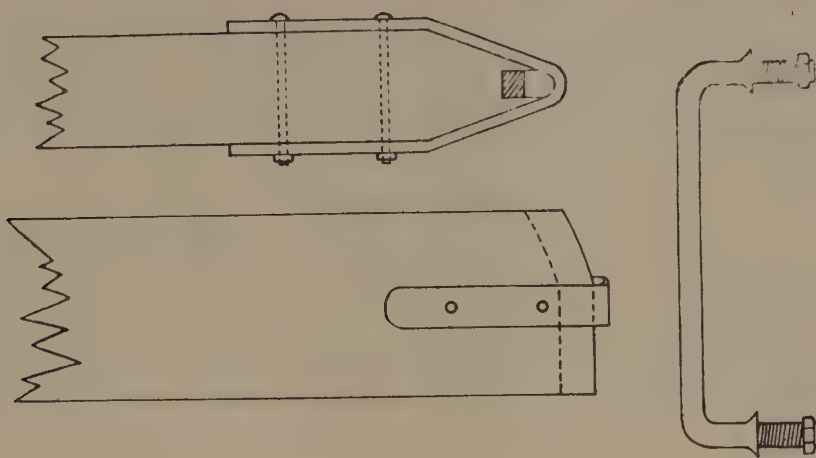

Plate 50.

Parts of the Dehorning Bail.—Top, looking down on top of handle of bail sword, showing the bevelled slot for sword slide; bottom left, side view of bail sword handle; right, slide for sword.

Dehorning and Speying Bail.

The dehorning and speying bail is placed about eight feet back from the dip to allow room to work in front. In Plate 49 the bail sword is seen to be fastened at its lowest end by a heavy bolt to crosspieces placed at ground level. This is to allow of the sword being withdrawn and cattle proceeding onwards as required to the dip.

Plate 51.

A Dehorning Bail on a New South Wales Holding.

[*Photograph by N.S.W. Dept. of Agriculture.*

The sword handle, which works through a large slot cut in the bail post, is connected to the sword by the attachment shown in Plate 50. This handle has an inch wide slot cut vertically into its inner end to receive the slide, which is made of $\frac{7}{8}$ in. round iron. The slot is cut on the slant so that on the upper surface of the handle it is $2\frac{1}{2}$ inches deep, but on the lower surface only one inch. Having made the slot, the sides of the inner end of the handle are shaped to form a blunt triangle and the upper crosswise edge is made into a bevel of approximately $1\frac{1}{2}$ inches. Finally a length of 1 in. by $\frac{1}{4}$ in. flat iron is shaped to match the end of the handle and is bolted on so as to form in conjunction with the slot a firm socket for the slide. The latter should be kept well greased when in use. The outer or working end of the handle may be rounded to facilitate handling.

When the bail is closed the sword handle is in the horizontal position and the working end can be secured by a bolt through a short post specially placed for the purpose. The ratchet device on the handle is an additional safeguard against a beast forcing the bail open.

Slide Gates.

These slide gates (Plate 52), three in number, could be of 6 in. by 1¼ in. sawn hardwood timber, bolted with ½ in. bolts, the nuts of which should be countersunk. They should be made just wide enough to fit within a few inches of the outside of the crush posts which are their guide, and high enough to be level with the top rail of the yard when swung.

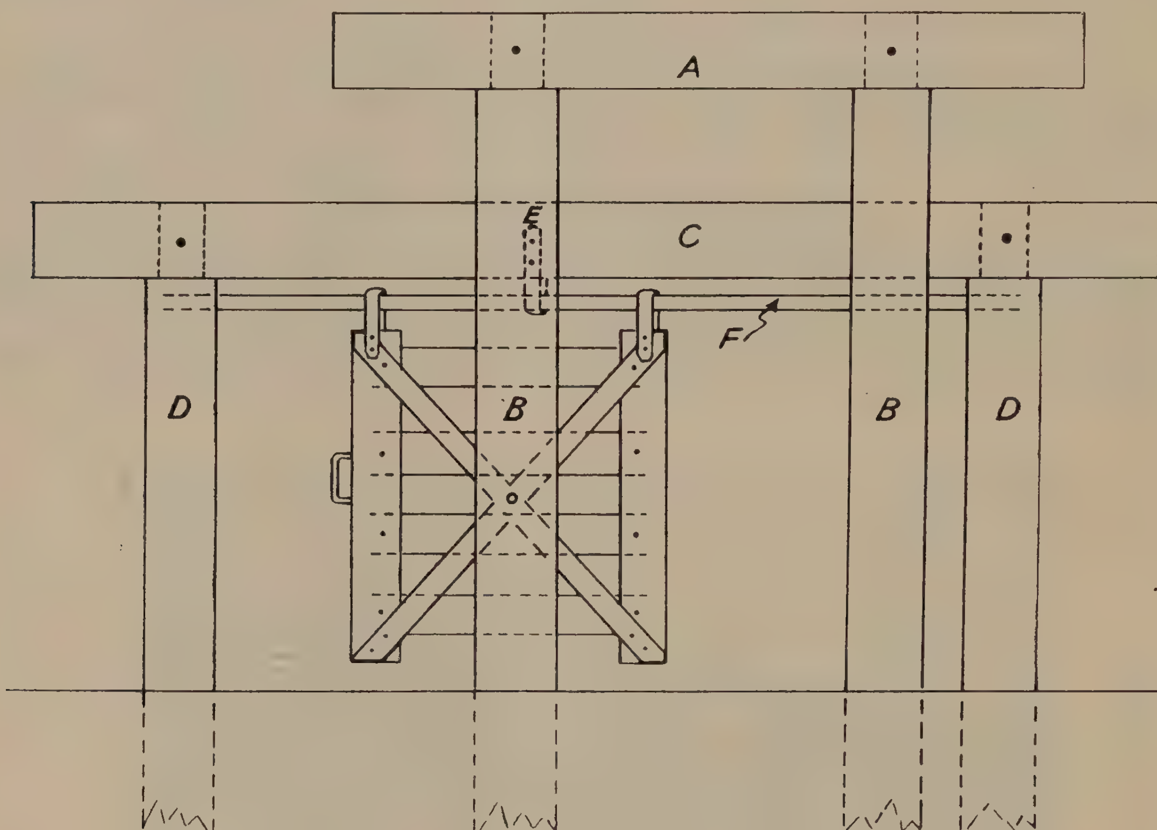

Plate 52.

Slide Gate in Half-open Position.—When the gate is closed it is prevented from swinging by the two sets of crush posts. A, crush cap; B, crush posts; C, sliding gate cap; D, sliding gate supports; E, centre support for slide rod, hidden by post; F, 1¼ in. mild steel rod or 2 in. galvanised piping.

The gates, which can be of two boards each as uprights with four boards set at even spaces within them, should be securely braced. This can be done with two 1½ in. by ¼ in. iron straps set crosswise from head to toe of the gate and bolted with the same bolts which fasten the boards. They are suspended by 1½ in. by ¼ in. iron straps from either 1¼ in. mild steel rod or 2 in. piping which is held in position by two strong posts 3 ft. 6 in. in the ground and about seven feet apart, one close to the crush and the other, on the working side, set sufficiently far out to allow the gate to clear the race, but not so far as to swing clear of the post. No exact dimensions are given here, as they depend on the size of the posts used. These posts could be joined overhead by a cap which also supports the rod about its centre, where it will not interfere with the free running of the gate along its length. This rod is kept well greased when in use.

There are several gaps marked "B" in the plan (Plate 42), which are necessary for the smooth working of the yard and to facilitate easy handling of the dip. These are usually just wide enough to allow a normal person to squeeze through and so eliminate constant climbing through or over yard fences. In the forcing pen the larger of the two gaps shown is provided specially for the safety of the person using the drafting gate should it be needed suddenly.

Dip Construction.

The dip (Plate 53), which is 40 feet overall, with the main portion 32 feet at working level, would hold approximately 3,200 gallons of dipping fluid when in use. It is 3 ft. 6 in. wide.

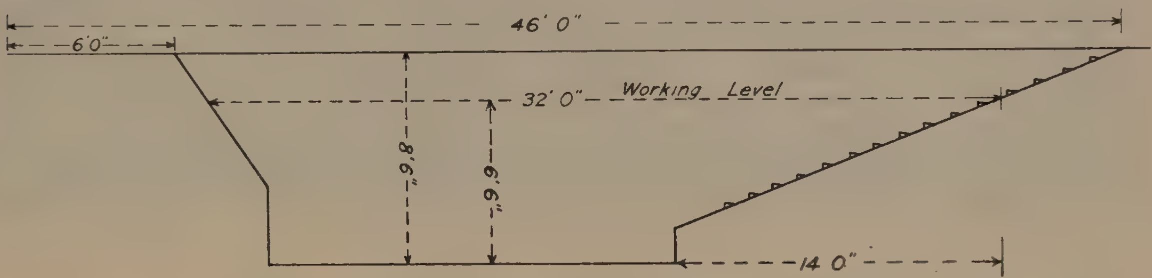

Plate 53.

Sketch of Concrete Dip With a Capacity of 3,200 Gallons.

A straight plunge-in is advocated at the entrance rather than a slide-in as ensuring complete immersion in the dipping fluid, and a walk-out incline suitably barred with steps at the exit. The lip at the entrance to the dip is concreted back for six feet to eliminate as much as possible the kicking of dirt into the bath. This lip, which is left roughened to avoid unnecessary slipping, has not been included in the overall length of 40 feet mentioned above. The lip or apron thus formed makes the floor of the crush between the last slide gate in the crush and the dip itself. All concrete work should be reinforced and for floors of this nature old barbed wire and wire netting help to strengthen it. Where heavy black soil cannot be avoided, a buffer of sand and gravel at bottom and sides of dip is a distinct advantage. This applies also to the concreted floor of the draining yard and wherever cement is used in the construction.

Splashboards are required along the side of each dip guard rail and these are usually three feet high and may be either 1 in. hardwood boards or galvanised iron, tarred. The dip should be roofed to avoid excessive evaporation. The plan shown allows for a single draining pen, and in practice where mobs of 300-400 are being dipped this is sufficient. However, a dual type pen may be added where thought necessary with little alteration to the plan, and may be an advantage where bigger mobs are being handled and where time is important.

The floor of the draining pen should be strongly constructed and reinforced. Cracked draining pen floors are a common fault which becomes progressively worse as moisture seeps through to the foundations.

The silt trap is on the working side of the dip so that a watchful eye may be kept upon it for choking and overflowing.

TUBERCULOSIS-FREE CATTLE HERDS.

(AS AT 10th JULY, 1951.)

Breed.	Owner's Name and Address of Stud.
Aberdeen Angus ..	The Scottish Australian Company Ltd., Texas Station, Texas F. H. Hutton, "Bingegang," Dingo
A.I.S.	F. B. Sullivan, "Fermanagh," Pittsworth D. Sullivan, "Bantry" Stud, Rossvale, *via* Pittsworth W. Henschell, "Yarranvale," Yarranlea Con. O'Sullivan, "Navillus Stud," Greenmount H. V. Littleton, "Wongalea Stud," Hillview, Crow's Nest J. Phillips and Sons, "Sunny View," Kingaroy Sullivan Bros., "Valera" Stud, Pittsworth Reushle Bros., "Reubydale" Stud, Ravensbourne H. F. Marquardt, "Chelmer," Wondai W. G. Marquardt, "Springlands," Wondai A. C. and C. R. Marquardt, "Cedar Valley," Wondai A. H. Sokoll, "Chelmsford," Wondai
Ayrshire	L. Holmes, "Benbecula," Yarranlea J. N. Scott, "Auchen Eden," Camp Mountain
Friesian	C. H. Naumann, "Yarrabine Stud," Yarraman J. F. Dudley, "Pasadena," Maleny
Jersey	W. E. O. Meier, "Kingsford Stud," Rosevale, *via* Rosewood J. S. McCarthy, "Glen Erin Jersey Stud," Greenmount J. F. Lau, "Rosallen Jersey Stud," Goombungee G. Harley, Hopewell, Childers Toowoomba Mental Hospital, Willowburn Farm Home for Boys, Westbrook F. J. Cox and Sons, "Rosel" Stud, Crawford, Kingaroy Line R. J. Browne, Hill 60, Yangan P. J. L. Bygrave, "The Craigan Farm," Aspley A. Verrall and Sons, "Coleburn Stud," Walloon R. J. Crawford, "Inverlaw Jersey Stud," Inverlaw, Kingaroy P. H. F. Gregory, "Carlton," Rosevale, via Rosewood E. A. Matthews, "Yarradale," Yarraman A. L. Semgreen, "Tecoma," Coolabunia G. & V. Beattie, "Beauvern," Antigua, Maryborough
Gurensey	C. D. Holmes, "Springview," Yarraman

RADIO TALKS TO FARMERS
(Australian Broadcasting Commission)
4QR AND REGIONAL STATIONS
THE COUNTRY HOUR—Daily from 12 noon to 1 p.m.
4QG AND REGIONAL STATIONS
COUNTRY NEWS MAGAZINE—Every Sunday at 9 a.m.

Horticultural Districts of Queensland.

7. Central Queensland.

K. KING, Senior Adviser in Horticulture.

CENTRAL Queensland figures in the annals of early Australian history, for it was at Round Hill Head, the southern point of Bustard Bay, that Captain Cook landed on 24th May, 1770.

In the year 1854, the township of Gladstone was founded, and Sir Maurice O'Connell was appointed as the first Government representative. A year later, William Archer settled at Gracemere, six miles from Rockhampton, and in 1856 Mr. W. K. Wiseman, then Commissioner for Lands, and Charles Archer chose the site on which the city of Rockhampton now stands. The Canoona gold rush in 1858, although a tragedy in some ways, laid the foundation for the development of both Rockhampton and the surrounding districts. In 1860, John Mackay and party set out from Rockhampton and eventually established themselves in the fertile valley of the Pioneer River on which the city of Mackay is situated. Thus, in a comparatively short period of six years, the pioneers of those early days laid the foundation of what is today Central Queensland.

GEOGRAPHICAL.

Central Queensland, for the purpose of this article, comprises a coastal belt of country extending approximately 450 miles from Rosedale in the south to Bloomsbury in the north and stretching westward to the South Australian and Northern Territory borders. The eastern portion is shown in Plate 54. The area is divided in four regions—namely Capricornia, Pioneer, Central Highlands and Western Plains—and contains in all 32 local authorities. Of the four regions, however, only Capricornia and Pioneer produce horticultural crops in quantity and production there is chiefly confined to a comparatively narrow coastal strip where the rainfall is relatively heavy and dependable.

Plate 54.

Sketch Map Embracing the Main Horticultural Districts of Central Queensland.

The district is served by the Central Railway and various branch lines which link Rockhampton to Longreach and other western towns, and by the Sunshine Route railway which runs from Cairns and Brisbane. There are approximately 1,713 miles of railway within the Central Queensland district, which is also well served by various airlines and numerous all-weather highways. Shipping facilities are available in the three main towns—namely, Gladstone, Rockhampton and Mackay. Gladstone is the point of departure for tourists travelling to the Capricorn and Bunker group of islands which form the southern portion of the Great Barrier Reef, and Mackay for the Cumberland and Whitsunday islands.

CLIMATE.

The climate is chiefly tropical in character, but temperatures in horticultural areas are seldom very high owing to the daily land and sea breezes. The winters are invariably short and mild, and only low-lying parts experience frosts, which are light. Along the coast the annual rainfall varies from 39.5 inches at Rockhampton to 66.6 inches at Mackay. Approximately two-thirds of the annual rainfall is registered from November to April, with peak monthly means between January and April, when monsoonal conditions occur. Most of the horticultural areas lie in the cyclonic belt and heavy blows accompanied by torrential rain are not uncommon during late summer. Winter rains are somewhat erratic and frequently insufficient to fully satisfy crop requirements.

SOILS.

As might be expected in such a large district as the one under review, many soil types are encountered.

The podsols and the sandy loams which form a large part of the coastal region are mainly utilized for grazing and contribute little to existing horticultural production. The red-brown loams, on the other hand, are used extensively for horticultural crops (Plate 55). These loams occur around Rosedale, parts of Yarwun, Mt. Larcom, Ambrose, Tanby, Yeppoon, Byfield, The Caves and St. Lawrence, and along the many foothills of the Coast Range from Carmila north to Sarina, Mackay and Bloomsbury. This soil type is reasonably fertile in its virgin state. It is well drained, comparatively easy to work and responds well to fertilizer. It occurs mainly on hill slopes where protection against erosion during heavy storm rains is essential. Very little trouble is encountered with deficiencies of trace elements such

Plate 55.

Pineapples on the Red-brown Loams Which Are Extensively Used for Horticultural Crops.

[*Photograph by E. T. Wannup.*

as boron, zinc and molybdenum. Some of these loams in the Yeppoon area, however, are rich in manganese, which is associated with an iron deficiency in certain crops in that area. As in the case of many other red loams, fertilizers are usually applied in bands to counteract the effect of phosphate fixation. Crops produced on the red-brown loams include pineapples, papaws, bananas, citrus, passion fruit, tomatoes, beans and melons.

Characteristically, the alluvial soils which are utilized for horticulture are situated near Rockhampton, at Gracemere, Nerimbera, Bouldercombe, Moore's Creek and Frenchville. They produce the bulk of the vegetables grown in the district, such as cabbages, cauliflowers, carrots, beetroot, lettuce, beans, peas, pumpkins and potatoes.

A sandy granite loam in the Yarwun-Targinnie area is also of horticultural interest. This soil is reasonably fertile, of considerable depth, well drained, and contrary to expectation, retains its moisture reasonably well. It is easily cultivated, but is rather subject to erosion. Large quantities of tomatoes are produced on this soil type as well as papaws of particularly high quality.

Many of the production areas in the Central District are comparatively new in comparison with those of southern Queensland. In the past as land became less productive more and more virgin soil was brought into use. However, the ever-increasing cost of preparing new land for cropping, together with the current scarcity of rural labour, has been responsible for bringing many old cultivated areas back into production. The application of modern methods of farming land management and the proper use of artificial fertilizers have made the re-establishment of these old areas possible.

Although the district has numerous large rivers and creeks, water facilities for irrigation are not good. The watercourses are either tidal or are far removed from existing production areas. Further, the underground water supplies are either inadequate or unsuitable for fruit and vegetable crops except in the basin of the Fitzroy River near Rockhampton. Hence fruit and to a lesser extent vegetable production is chiefly dependent on seasonal rains.

VEGETATION.

Open eucalyptus hardwood forests form by far the greatest portion of the vegetation, the chief species being blue gum, bloodwood, narrow-leaf ironbark, grey box and stringy bark. In swampy areas, tea tree and banksias predominate. Light softwood scrubs occur on some of the better soil types and are characteristic of the more highly developed farming areas. Dense rain forest is found in the heavier rainfall belt around Mackay and to a smaller extent at Byfield.

HORTICULTURAL USES.

With the exceptions of some fruit crops, horticultural production in Central Queensland reached its peak during World War 2 when large quantities of fruit and vegetables were required for the Services. Although production has since declined, a perusal of Table 1 will give some idea of its importance to the district.

TABLE 1.

Horticultural Production—Central Queensland District (1949-50).

FRUIT.

Crop.	Not Bearing.	Bearing.	Production.
	Trees.	Trees.	
Citrus—			
Navel oranges	994	1,789	2,033 bushels
Valencia oranges	5,988	7,055	7,035 bushels
Other oranges	2,784	54,52	5,414 bushels
Lemons	1,085	2,351	1,654 bushels
Mandarins	5,064	7,405	4,364 bushels
Custard apples	936	598	218 bushels
Mangoes	547	2,596	3,269 bushels
	Acres.	Acres.	
Table grapes	6	59	54,884 lb.
Bananas	122	309	15,422 1¼ bush. cases
Pineapples	101	406	238 tons (factory)
			50,384 1½ bush. cases
Papaws	136	225	30,980 bush. cases
Passion fruit	2	33	2,300 ½ bush. cases

VEGETABLES.

Crop.	Acres.	Production.
Potatoes—		
English	354	831 tons
Sweet	38	64 tons
Turnips	17	52 tons
Carrots	28	1,569 cwt.
Beetroot	7	244 cwt.
Onions	6	7 tons
Tomatoes	491	74,509 ½ bush. cases
French beans	118	7,500 bushels
Green peas	73	3,145 bushels
Cabbages	80	19,661 dozen
Cauliflowers	29	5,749 dozen
Lettuce	6	2,873 bushels
Melon—		
Water	104	270 tons
Rock	83	148 tons
Pumpkins	807	1,559 tons
Marrows and squashes	13	22 tons
Cucumbers	91	9,383 bushels
Other vegetables	31	..

Pineapples.

The main varieties of pineapple are the smooth-leaf Cayenne (Plate 56) and the rough-leaf Ripley and Alexander. Rough-leaf types have been grown for many years and enjoy a wide popularity as a fresh fruit on all Queensland markets. They are less popular on interstate markets, where the consumer demand is for the Smooth Cayenne. In recent years a notable expansion has taken place in the area under the Smooth Cayenne, which, besides being used as a fresh fruit, is also canned. The establishment of a growers' co-operative cannery at Northgate in southern Queensland has given a decided impetus to the pineapple industry in the Central District. Potentialities for further expansion are bright, as the tropical climate favours early maturation of the fruit,

particularly in the summer crop. The Yeppoon area, which embraces Tanby, Emu Park, Farnborough, Woodbury and Adelaide Park, is the main production centre. Other notable areas are Gracemere, St. Lawrence and Bucasia, which is near Mackay. Ample land is available for the expansion of the industry in most of these areas.

Plate 56.

Young Pineapple Crop near Rockhampton.—The crop may be grown either in single rows as illustrated or in double rows; the latter is more usual.

[*Photograph by E. T. Wannup.*

Bananas.

The banana industry has been established for many years (Plate 57). It reached the peak of its production about 1930, when rain forest soils at Yeppoon and Byfield and near Mackay were planted up extensively. Immediately afterwards, however, the industry in the whole of Queensland went through a very difficult period, characterised by low returns to the grower, and production rapidly declined. The banana area then remained fairly static, but a succession of droughts and occasional cyclonic winds have caused a further decline in the acreage under crop over the last few years. Although the soil and most climatic factors are suitable for banana production, the rainfall is so uncertain that the industry is unlikely to become as important as it is in southern Queensland. However, there is scope for expansion in the northern portion of the district from Carmila to Bloomsbury, where the rain is more dependable and large tracts of suitable land are still undeveloped.

The dwarf Cavendish is the main variety. Mons Mare is growing in importance but the lack of adequate supplies of planting material is retarding progress. Sugar bananas, which are well received on the market, are also grown to some extent.

Plate 57.

Banana Plantation of the Cavendish Variety.—Crops are grown on recently cleared forest country.

[*Photograph by E. T. Wannup.*

The district is free from bunchy top disease, but banana weevil borer and banana rust thrips are fairly prevalent. Panama disease is present in some of the areas where tall varieties are grown.

Papaws.

Papaws (Plate 58) are grown in most parts of the district, including Yarwun, Yeppoon, Ambrose, Bouldercombe, The Caves and around Mackay. Yarwun is the biggest production centre. Although the 1949 cyclone gave the industry a severe set-back, new plantings have made good these losses and production is now back to normal. That the soil and the tropical environment are ideally suited for papaw production is demonstrated by the excellent reputation of the fruit wherever it is marketed. Dioecious types are mainly grown, and although generally variable in shape and size, they nevertheless have reached some degree of uniformity in the Yarwun area, where a local strain has been selected and grown for many years.

The two new varieties, Bettina and Improved Petersen, released in southern Queensland are at present under trial at Yeppoon and Yarwun. Dieback is the most troublesome disease, particularly on the heavier loams around Yeppoon and The Caves.

Citrus.

The citrus industry ranks among the oldest in the district. Seedling citrus were first planted at Byfield over 50 years ago. Many of these trees are still in production and excellent crops of both oranges and mandarins are harvested annually. Byfield is the only place where

Plate 58.

Papaw Plant Bearing Its First Crop of Fruit.—Commercial plantations last from three to five years.

[*Photograph by E. T. Wannup.*

citrus is harvested in quantity. Production elsewhere is limited to scattered orchards throughout the district, including more inland areas such as Barcaldine, Bogantungan, Clermont, Yamala and Dingo. Because of the lack of adequate irrigation facilities, no immediate expansion of any consequence is visualised and production will be limited to local market requirements for some considerable time.

The main varieties are Late Valencia, Washington Navel, Joppa and seedling oranges, Emperor mandarin, Marsh grapefruit, and Lisbon, Villa Franca and Genoa lemons. Because of the prevalence of certain pests and diseases, spray programmes must be strictly observed.

Grapes.

Grapes (Plate 59) are grown chiefly around Rockhampton and Westwood. At Westwood a vineyard planted approximately 50 years ago is still producing excellent crops. Muscat Hamburg is the main variety. The fruit matures a week or so before Christmas and meets a very ready demand. Prospects for expansion are good, particularly if the possibilities of air-freighting to southern markets are exploited by growers.

Plate 59.

Harvesting Muscat Hamburg Grapes Near Rockhampton.

[*Photograph by E. T. Wannup.*

Passion Fruit.

The inroads of diseases such as Fusarium wilt and woodiness have seriously affected the production of passion fruit in Central Queensland. Yeppoon, which for many years was a large production centre, is no longer interested in the crop, and only limited quantities are grown at Yarwun, Milman, St. Lawrence, and parts of Mackay. The main crop matures during the spring and early summer when dry weather is usual, and fruit shrivelling, accompanied by heavy losses, often occurs.

Custard Apples.

Production is mainly confined to seedling types. Compared with Pink's Mammoth, the principal variety in southern Queensland, the fruit is smaller and contains a much greater number of seeds. The tree, on the other hand, is very hardy and has the advantage of regularly producing crops. A few good trees of the Pink's Mammoth variety are also under cultivation but in general the cropping of this variety has been very disappointing.

Mangoes.

No really serious attempt has been made to grow the mango in Central Queensland on a commercial scale. Trees have been mainly planted for ornamental or shade purposes rather than fruit production. That mangoes can be successfully grown is evidenced by the many beautiful trees throughout the various parts of the district. At Bucasia, near Mackay, an attempt has been made to establish orchards of the better types such as the Kensington, and although the trees are still young the venture appears to have promise.

Plate 60.

Young Tomatoes Grown under the Trellis System.—The plants will be trained to two arms which grow up the V string looped over top and bottom wires.

[*Photograph by E. T. Wannup.*

Tomatoes.

Tomatoes are grown in practically all farming areas and play a very important part in the district's prosperity. Production is maintained throughout the greater part of the year. Planting commences at the beginning of February and continues until approximately September, but the largest acreage is set out during the May-June period to supply the southern markets during late winter and spring. Because irrigation facilities are limited, production is mainly dependent on

good seasonal rains. For the same reason, staking or trellising (Plate 60) is rarely practised and most crops are grown by the bush method. The most favoured varieties are Sioux, Grosse Lisse, Rutgers, Break o' Day and Pearson. Plant protection against pests and diseases is necessary.

The use of fertilizers, together with the choice of better varieties and a better appreciation of the importance of pest and disease control by farmers, has done much in recent years to bring about a considerable improvement in the average production per acre.

Vegetables.

Vegetable production for the greater part is confined to localities where suitable irrigation facilities are available. The best irrigable soils for vegetables are near Rockhampton, which is the district's largest market. Horticultural areas in Central Queensland are too far from the interstate markets to encourage large-scale production and growers are therefore usually concerned with supplying local requirements over the longest possible period during the year. Modern developments in plant protection and a careful selection of varieties have done much to prolong the cropping period. The vegetables grown include cabbages, cauliflowers, root crops, lettuce, cucurbit crops, beans and peas. Included in the cucurbit crops is a gourd commonly known as Guada bean, which is a popular vegetable on the local market and is an excellent substitute for greens during the hot summer months.

Lettuce, which were once solely produced by Chinese gardeners, are now grown commercially by Australians. During the summer months this crop is difficult to handle and calls for specialised management. The most popular variety is a local selection—a legacy from Chinese gardens—now commonly known as Chinese or Summer lettuce. It produces excellent heads during the hot summer months.

THE FUTURE.

The Central Queensland horticultural district is one of the largest in the State. It still contains vast areas of undeveloped or only partly developed land and thus has distinct potentialities for the future. At the moment, the acreage under pineapples, papaws and to a lesser extent tomatoes is expanding. Of these crops, the pineapple is by far the most stable, for the tropical conditions favour the production of high quality fruit for which there is a good payable outlet. The papaw is another fruit which, when handled with care, can be placed in good condition on southern markets, where Yarwun fruit already enjoys a reputation for excellent quality. Both crops withstand dry seasonal conditions particularly well. Tomatoes have been produced in quantity for many years, but the crop is almost entirely dependent on good seasons and the annual output is therefore variable. As the crop grows quickly and requires only a small capital outlay, it will always play an important part in the horticulture of the district.

Summing up, it appears that the future of horticulture in Central Queensland depends on specialisation in crops which (*a*) are best suited to the soil and climate; (*b*) may be placed on southern markets; and (*c*) are capable of being processed. Should the district's natural resources like Callide and Blair Athol coal be more fully exploited and industrial development follow, horticultural production could readily keep in step with the needs of an increased population and in so doing consolidate its own future.

Salmonellosis in Transported Rams.

G. R. MOULE and R. B. YOUNG, Sheep and Wool Branch.

IT is well known that bacteria can be identified according to their shape, the way they stain, the nutrients they require for normal growth and reproduction, the way they ferment certain sugars, and their requirements with regard to atmospheric conditions. A group of organisms which are of considerable importance because of the disease conditions they produce, and which can be identified by cultural methods, was named Salmonella after the eminent American bacteriologist Salmon.

Salmonellosis refers to the establishment in the animal's body of an infection by organisms of the Salmonella group. These organisms commonly affect the small intestines and as a result profuse scouring occurs. Heavy mortality commonly results from severe outbreaks of salmonellosis.

Until recently the disease had been reported only on a few occasions amongst sheep in Australia. Investigations carried out by officers of the Queensland Department of Agriculture and Stock into mortality occurring amongst Merino rams in transit from studs in New South Wales and South Australia to western Queensland have established that salmonellosis is quite common and that it may result in serious losses.

Ever since it became possible for rams to travel the whole journey from southern studs to western Queensland by rail, losses have been reported, though little trouble seems to have occurred in earlier days when animals were moved by boat from Sydney to a convenient port in Queensland for distribution to various properties. In some consignments by rail half the number of travelling rams have been affected, and on more than one occasion at least a quarter of the total draft has died within a few days of completing the journey. These losses are of considerable importance, as they may restrict the number of rams available for joining.

History of Affected Rams.

Enquiry has revealed that the majority of stud breeders like the sheep they sell to be in good condition when they are delivered, and to ensure this rams are commonly grazed on irrigated or improved pastures for a fortnight or so before they are consigned.

While in transit from South Australia or from the majority of studs in New South Wales the animals are subjected to prolonged periods of starvation, as they may travel several stages each of from 48 to 72 hours duration. These are broken by spells of about 24 hours during which the animals are offered cereal or lucerne hay.

Usually the first signs of trouble amongst the travelling rams are observed as they approach the New South Wales—Queensland border, and almost invariably some losses have occurred before the animals reach their destination. While it has not been possible to get detailed information about the feeding of all sheep en route, it has been established that in many instances the rations provided for the sheep at the spelling points are inadequate. There is also evidence that rams which have been starved for some time do not regain their appetite for a considerable time, and the comparatively short spelling periods may be insufficient to ensure a return of their normal appetite.

These facts are of importance because they probably pre-dispose travelling rams to attacks of salmonellosis. Apparently the establishment of severe infection is dependent partly upon the amount and nature of the food available to the sheep. The paunch of sheep which have been on succulent pastures soon empties when the animals are starved and these sheep regain their appetite slowly. The emptying of the paunch may facilitate the establishment of severe infections of bacteria belonging to the Salmonella family, and accordingly is to be avoided when rams are in transit.

Symptoms.

Persistent scouring is the most striking symptom exhibited by sheep suffering from salmonellosis. The faeces become so fluid that they are about the consistency of paint. They are usually greenish or yellowish in colour and are evil smelling.

The affected rams become dejected; they do not eat, but will drink small quantities of water frequently. Sometimes they stand with their backs arched and with their hind feet tucked up under their forefeet, in an effort to take weight off the floor of the belly.

The temperature of the sheep is raised and the blood vessels of the eyelids become inflamed.

As the disease progresses the sheep rapidly lose condition, become weaker, and finally collapse and die. They may be sick for from three to five days before death supervenes, but not all affected sheep die. Recovery is usually protracted and it may be two weeks before scouring ceases. Six to eight weeks may elapse before recovered rams regain their condition.

Post-mortem Findings.

The post-mortem findings are not very spectacular, although they are characteristic of the disease. There is slight engorgement of the blood vessels under the skin and the muscles may be dark.

The small intestines are usually empty and their lining is inflamed. Sometimes these changes extend up to the fourth stomach and down to the lower bowel, which may show patchy areas of ulceration. The lymph glands of the small intestines are slightly enlarged and the gall bladder is distended and sometimes inflamed.

There may be an aggregation of fluid in the heart sac and a few dark haemorrhages on the heart muscle.

Treatment.

The drug sulphamezathine is useful for administration to sheep suffering from salmonellosis. It is available as white tablets, each weighing half a gram, or as a 33 per cent. sodium solution.

The tablets can be administered by mouth at the rate of 1 gram (that is, two tablets each of half a gram) per 10 lb. liveweight for the initial dose, followed by half a gram (one tablet) per 10 lb. liveweight a day thereafter.

The sodium solution can be injected into the jugular vein or into the abdominal cavity. The dose rate is 3 c.c. per 20 lb. liveweight, followed by 1½ c.c. per 20 lb. liveweight each day until recovery.

Great care is necessary in making these injections. Treatment should be commenced early and affected rams should be withdrawn from the rest of the flock.

Preventive Measures.

The main preventive measures to consider are as follows:—

(1) Feed rams an adequate ration of fibrous fodder, such as cereal or lucerne chaff and oats, for a fortnight or three weeks before they commence their rail journey.

(2) Keep them off irrigated or succulent pastures or overgrazed areas.

(3) Ensure that travelling rams are spelled frequently and that they eat well. They should be fed bulky rations, consisting mainly of roughage, while in transit.

(4) Pay particular attention to cleanliness in feeding rams in transit. The feed should be offered in clean troughs, and not dumped on ground heavily soiled with faeces. Clean water troughs carefully.

(5) If a ram commences to scour, remove him from the draft. The organism which causes the disease is passed in the faeces. An affected sheep could contaminate the feed or water and be responsible for spreading the complaint to the remainder of the draft.

The Cultivation of Some Salad Vegetables.

K. M. WARD, Senior Horticulturist, and C. N. MORGAN, Senior Adviser in Horticulture.

THE term salad vegetables refers to a group of plants which are valued in the diet for their mineral and vitamin content and used most commonly during the warm months of the year. They are always eaten in the fresh state with or without cold meats, cheese and other foods. The tomato and the lettuce are basic ingredients in most salads, but many others, such as celery, parsley, cress and spring onions, are used when available. The cultivation of three important salad vegetables—tomato, lettuce and shallot—is described in this article.

TOMATO.

The tomato (*Lycopersicum esculentum*) is native to tropical America and though known in Europe prior to 1600 it was not grown for culinary purposes until after 1750. Since then great strides have been made in the development of the crop. The tomato belongs to the botanical family Solanaceæ, which contains a number of important species, including potato, tobacco, egg plant and cape gooseberry. The plant is grown as an annual and its fruit is technically described as a berry.

Climatic and Soil Requirements.

Though the tomato is a warm-climate plant, it is grown in both temperate and tropical countries on a wide range of soil types. The plant will not withstand frosts and grows most rapidly at temperatures between 75 deg. F. and 88 deg. F. Hot winds cause blossom drop while cold winds seriously damage the foliage and interfere with fruit setting. The plant thrives under irrigation where atmospheric conditions are dry. It is grown as a summer crop at Stanthorpe on the southern tablelands of the Great Dividing Range, and as an autumn, winter and spring crop in coastal Queensland.

The tomato is produced on a variety of soil types, including sands, red volcanic loams, and clay loams. The plant grows more quickly on light than on heavy soils and the former are preferable where earliness is desired. However, loamy soils are likely to give greater yields. Good drainage is essential and a plentiful supply of organic matter is most beneficial.

The Seed-bed.

Climatic conditions in Queensland permit the use of open-air seedbeds and only occasionally is it necessary to protect the plants against late frosts. It is worth while taking the trouble to raise sturdy, healthy

plants. The seed-bed should therefore be dug deeply, brought to a fine tilth and preferably raised four to six inches above ground level. The fertility of the bed is increased by adding a small amount of fertilizer and well rotted manure to the soil a week or more before sowing. The seeds should be sown a quarter of an inch deep in rows four to six inches apart and five or six to the inch. After covering the seed, the soil should be firmed gently with a flat board and lightly watered.

Though the seed-bed will require watering, care must be taken not to over-water and thus encourage damping-off disease in the seedlings. In warm weather, one watering each morning is usually needed, but in cool weather two waterings a week may suffice. A fine spray should be used. In warm districts the seedlings will be ready for planting out in four to six weeks, but in the tablelands the seed-bed period may be as much as eight weeks.

There are about 10,000 seeds per ounce and it is advisable to sow about 1½ ounces of seed for each acre of the crop to be established in the field.

Fertilizers.

In addition to organic manures, which should be incorporated with the soil during the preparation of the land, artificial fertilizers serve a useful purpose. In Queensland, the tomato plant responds to fertilizer mixtures containing approximately three parts of phosphoric acid to one part of nitrogen. Suitable mixtures on the market contain nitrogen, phosphoric acid and potash in the following proportions—5:13:5; 5:14:5; 5:13.5:4 and 4:12:6. Some of these mixtures contain a proportion of blood and bone.

The rate of application varies with cultural conditions, soil fertility and the spacing of plants. On moderately fertile soils, a suitable pre-planting application would be 8 cwt. per acre of a 5:13:5 or similar fertilizer mixture. This is equivalent to 5½ lb. to each chain of row if the rows of plants are four feet apart. A typical fertilizing schedule for a ground crop is as follows:—

Basal dressing applied in the furrows before planting—5:13:5 (containing blood and bone) at 8 cwt. per acre;

Side dressing at early flowering—5:13:5 (a quick-acting water-soluble) at 4 cwt. per acre.

Cluster types of tomatoes grown on trellises or stakes during cool weather benefit from light side dressings of sulphate of ammonia or quick-acting complete fertilizers applied at regular intervals during the growth of the crop.

Field Planting.

Soil preparation for tomatoes includes at least one deep cultivation. When organic matter is used, it should be incorporated in the soil about three to six weeks before field planting to allow sufficient time for its decomposition and the settling of the soil.

Before transplanting, the seedlings may be hardened off in the seed-bed for a few days by withholding water, but just before lifting the plants the seed-bed should be well watered. As the plants are taken out, most of the older leaves are removed but the growing tip is left intact. Only sturdy plants not more than eight inches high should be used (Plate 61). When setting out, the plants should be placed at least three inches deeper in the soil than they were in the seed-bed, and it is good practice to spread the roots before filling in the hole. Water should then be applied to each plant to settle the soil around the roots.

Plate 61.
Tomato Seedlings.—The leaves will be trimmed to reduce transpiration when the plants are set out in the field.

Plate 62.
Ground Tomatoes.—A crop of Rutgers in the Stanthorpe district. Strains of this variety are widely grown in southern Queensland.

Planting distances depend on the variety grown. Dwarf types planted as ground crops (Plates 62 and 63) are set out about 30 inches between plants and four to five feet between rows. Normally, ground crops grown in coastal districts are planted with a 3-feet spacing between plants and a 6-feet spacing between rows (equivalent to about 2,000 plants per acre), though in home gardens closer planting may be adopted. If the crop is staked, the plants may be set out 18 inches apart in rows with a 4 ft. 6 in. spacing, thus allowing up to 7,000 plants per acre. Trellised plants are also planted closely. Cradled plants are usually planted a little closer than ground crops, so there are about 3,000 plants per acre.

Plate 63.

Gound Tomatoes.—A well grown crop of Rutgers in the Redlands district.

Crop Management.

Shallow cultivation is necessary to control weeds. However, all cultivation of ground crops must cease once the plants have covered the soil in order to avoid damage to both the vines and the fruit clusters.

Training and pruning is essential for staked and trellised plants (Plate 64). The plants are trained to a single or double stem by pinching out all lateral shoot growths from the axils of the large leaves. Single stems are tied to stakes with strips of rag or soft thick twine (Plate 66) or twisted round the trellis string. The growing point is pinched out when the plant reaches the required height. Cradled crops do not require pruning but the plants are trained on to wires (Plate 65). Unpruned plants will generally give better individual yields than those that are pruned.

Tomatoes require a moist soil for best growth but excessively wet conditions lead to the production of inferior quality fruit. Heavy but infrequent applications of water are preferable to many light waterings. The quantity of water applied in dry weather should not exceed that necessary to penetrate the root zone, and where there is a clay band near

Plate 64.

Trellised Tomatoes.—Trellising is a standard method of growing tomatoes in the Brisbane district during the cooler months of the year.

Plate 65.

Cradled Tomatoes.—The plants are trained on to wires in the form of a cradle.

the surface only sufficient water should be applied to reach this band. Over-watering not only lowers the quality of the fruit but also tends to wash soluble fertilizers down below the root zone.

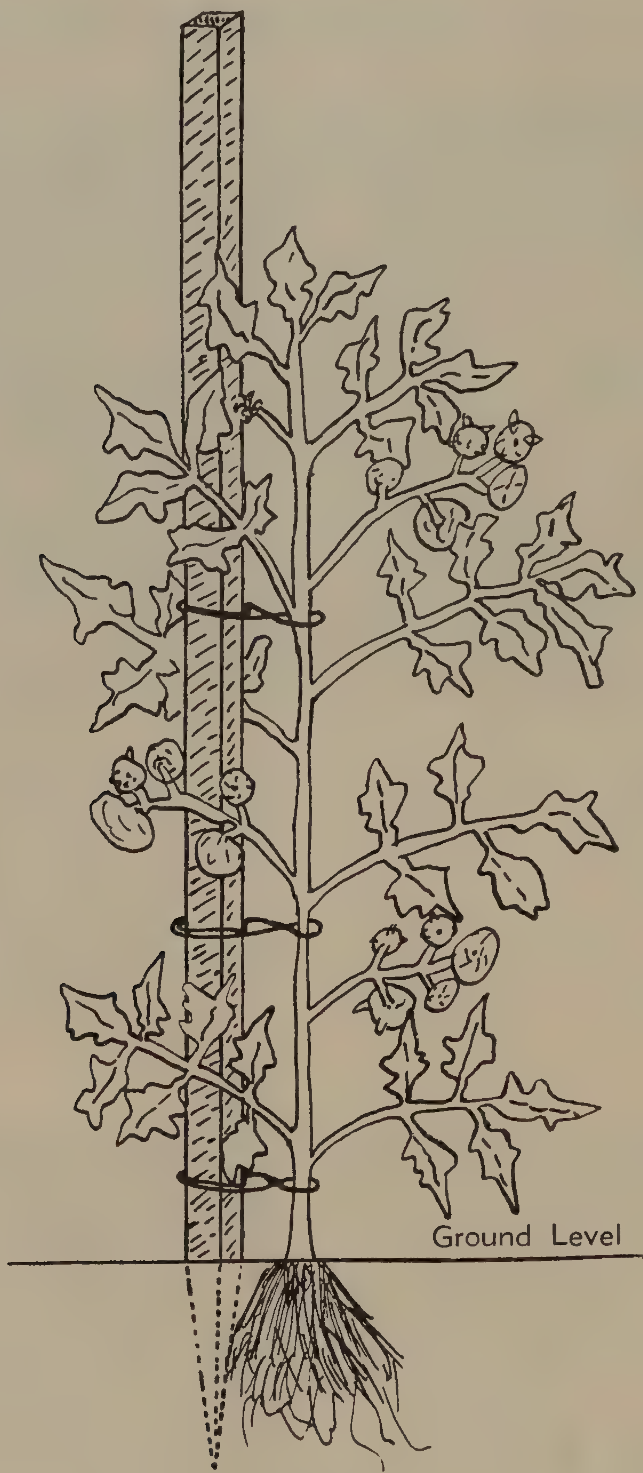

Plate 66.

Staked Tomatoes.—The diagram shows the method of tying the plant to the stake.

Varieties.

Broadly speaking. there are two groups of tomato varieties grown in Queensland. One group is suitable for ground crops; the other is preferred for off-the-ground crops which are normally staked or trellised. Varieties in the latter group, often referred to as cluster types, tolerate cool conditions and are pruned to increase the size of the fruit; they require both training and forcing.

Varieties recommended for planting at different times of the year are:—

For Coastal or Warm Climate Districts.

Time of Planting Out.	Varieties Recommended.
February to March (ground crops)	Q1 or Sioux, Q2 or Grosse Lisse, Q4 or Rutgers, Red Cloud and Break o' Day.
April to May (off-the-ground crops)	Salads Special, Potentate and Geraldton Smooth Skin.
June to August (ground crops)	Q1 or Sioux, Red Cloud and Break o' Day.

For Cool Tablelands.

Time of Planting Out.	Varieties Recommended.
October to February (ground crops)	First choice: Q1 or Sioux, Q2 or Grosse Lisse, Q3 or Valiant, Q4 or Rutgers. Second Choice: Among others, good varieties are Break o' Day and Pearson.

LETTUCE.

Lettuce (*Lactuca sativa*) is grown most successfully during the cooler months of the year. In summer the plants seldom produce a good heart and although the heads are large they would be classed as loose-leaved. Provided it is supplied with adequate moisture and plant food, almost any well-drained soil will grow good lettuce.

Manures and Fertilizers.

Without ample supplies of farmyard manure, lettuce growing is difficult. Unfortunately, this manure is not available to all growers and fertilizer applications are therefore heavy. The main fertilizer used is blood and bone, which is broadcast a week or so prior to planting. The amounts used vary from 10 cwt. to 15 cwt. per acre. Topdressings are often necessary on the growing crop and nitrogenous fertilizers such as sulphate of ammonia, nitrate of soda and dried blood are all used. The first topdressing may be made soon after thinning and the second when the plants are nearly half grown. The topdressing should not exceed 400 lb. per acre and each application should be followed by an irrigation.

Soil Preparation.

All land for lettuce must be thoroughly prepared. At least two ploughings are necessary, followed by harrowing and cultivating until the soil is in a fine state of tilth. When sowing lettuce direct into the field, it is essential to have the land reasonably level and free from lumps.

Planting and Thinning.

Two methods of planting are usually adopted. The first is to plant on raised beds (Plate 67) sufficiently wide to take four rows approximately 12-15 inches apart. The method of making the beds is to throw in two furrows approximately six feet apart by means of a single furrow plough or a hiller attached to a cultivator. The bed may then be levelled. Raised beds are used on heavy or shallow soils to improve the drainage. The second system is to plant direct in the field without hilling (Plate 68). Rows are made about 15 inches apart to allow the use of a hand cultivator. Where horse cultivation is practised, rows will have to be two feet apart.

Plate 67.

Bedded Lettuce.—The crop has been grown on raised beds with four rows to the bed.

With both methods, the seed is drilled along the the row and sown shallow. Thick seeding should be avoided, as the work involved in thinning is laborious and expensive. From 1 to $1\frac{1}{2}$ lb. of seed should be sufficient to plant an acre when using a planter but more is required for hand planting. Lettuce usually take from eight to 10 weeks from sowing to reach market condition.

Approximately three to five weeks after sowing, the plants should be thinned to about 10 inches apart.

Plate 68.

Lettuce on the Flat.—The crop is about half grown and has been planted to permit inter-row cultivation.

Cultivation.

Cultivation should be shallow and fairly frequent, for lettuce is a shallow-rooted plant and weed competition is harmful. Small hand cultivators may be used to keep down weeds between the rows, but in the rows hand chipping is necessary. A topdressing may be applied before cultivation, as the fertilizer is then immediately worked into the soil.

Irrigation.

Practically all lettuce are irrigated by overhead sprays. The crop requires a plentiful supply of water, particularly during the warmer months. Lack of moisture results in stunting, slow growth, bitter flavour and an increased tendency to bolt in warm weather.

During the winter months, irrigation is done sparingly and normally no great effort is required to keep an even supply of moisture in the soil during this period. In the summer, however, the full use of irrigation facilities is essential during dry weather. On well-drained sandy and volcanic soils, it will commonly be necessary to apply water every second or third day at this time of the year. Light waterings in between the main irrigations keep the soil cool and prevent wilting in the middle of the day.

Overhead watering should be done early in the morning or in the late afternoon. Should a grower find his irrigation supply below requirements, the available water should be used on half-grown plants rather than on those which are nearly mature.

Harvesting.

Lettuce should be harvested as soon as they have reached maturity. Winter lettuce are mature when the hearts are firm. Summer lettuce, being loose-leaved, may be cut when they reach reasonable market size. Cutting is done either late in the afternoon of the previous day or early in the morning of the day of marketing. The former practice is quite satisfactory in winter while the latter is more desirable in summer.

Varieties.

The most popular types of lettuce are those known as the crisp varieties, which have crisp, curly leaves and develop a large, solid head. Cos and other loose leaf varieties are not often grown commercially but are common in the home garden. The principal crisp varieties grown in Queensland are—

Imperial 847	Grown all the year round.
Imperial 44, Seedless and Great Lakes	Preferred for summer growing.
Imperial 615 and New York	Preferred for winter growing.
Mignonette	A small, home garden variety, suitable for planting the year round.

SHALLOT.

The shallot (*Allium ascalonicum*) is a perennial and seldom seeds but the bulb as planted divides into numerous bulbils or cloves which remain attached at the base. The crop is used mainly as a salad green but sometimes the dry bulbs are used for seasoning or as a mild substitute for onions.

Propagation is by means of cloves which are separated from the dry bulb and planted out singly in early spring or autumn. The cloves should be set out in rows 9-12 inches apart in rich, well-prepared soil. When grown for use in the green state, planting to a depth of at least three inches is recommended so that long, well-balanced and succulent tops may be obtained. Under suitable conditions, plant growth and multiplication of cloves are rapid and the crop can be pulled or dug three or four months from planting out. At this stage, the bulbs are still soft and the earthed portion of the stalk is white; the aerial portion is, however, quite green.

When the crop is grown for the dry bulbs, shallow planting is practised and the soil is from time to time drawn away from the plants during their growing period until as they approach maturity they are practically sitting on top of the earth. This treatment encourages the filling out and hardening of the bulbs. Under this method of growing, the bulbs are not harvested until the tops have begun to wither, and after drying out they are divided and stored in a cool place.

Progress in Tea Trials.

For some time past, tea growing experiments have been proceeding at the Department's Bureau of Tropical Agriculture at South Johnstone, on the northern coastal plain. It has been demonstrated that tea of good quality can be grown on the lowlands of the north, and it is now proposed to make plantings at higher altitudes in order to test the suitability of the crop for various conditions.

A mechanical tea cropper has recently been tested at South Johnstone with promising results. Trials with the cropper will be continued, and studies of the type of bush most satisfactory for mechanical harvesting will be made.

The Relationship of Crops to Dry Farming Practice in Queensland.*

L. G. MILES, Senior Plant Breeder, Agriculture Branch.

THE areas with which I propose to deal under the heading of dry farming in Queensland are those in which crops are grown under natural rainfall whose average is less than 30 inches per annum. In actual fact such areas lie mainly between the 25 inch and 30 inch isohyets and include such important districts as the Darling Downs, portion of the South, Central and Upper Burnett districts and the Callide and Dawson Valleys.

While such rainfalls may appear bountiful to southern Australian farmers, they are characterised by two important factors:—(i.) their unreliability, and (ii.) their major incidence during periods of high temperature, coupled with high evaporation and high transpiration. These factors are responsible for frequent seasonal shortages and make necessary some form of moisture conservation if farming is to be successfully pursued. Typical rainfall data are those for Pittsworth, Dalby, Monto and Biloela.

—	Mean Annual Rainfall.	Percentage Oct.–Mar.	Evaporation.
	In.		In.
Pittsworth	27	66	53·0
Dalby	26	66	58·0
Monto	29	70	54·6
Biloela	28	72	77·25

Winter versus Summer Crops.

Under these conditions of predominantly summer-autumn rainfall it may at first sight seem paradoxical that the major agricultural crop in this region is wheat, whose growing period covers the winter and

* This paper was presented to the Agriculture and Forestry Section of the Brisbane Meeting of the Australian and New Zealand Association for the Advancement of Science.

spring months. One reason for this is of course economic, being related to relative requirements of farm products and the prices offering for them. Another important reason is, however, that in much of this country winter cropping is regarded as more reliable than summer cropping. This refers particularly to the heavier fertile clay soils of high moisture holding capacity which are eminently suited for moisture conservation by fallowing.

While the bulk of the rainfall occurs during the warmer months of the year, such rains occur erratically, frequently in torrential bursts, and usually interspered with heatwave periods of variable severity and duration. Thus a summer of better than average rainfall could well prove to be a mediocre or poor season for crop production on account of the uneven distribution and severe inter-rainfall periods. With successful fallowing practice, however, much of this summer incidence can be retained within the soil, irrespective of its actual distribution, and thus become available for the use of winter crops. The major crop requirement is then a suitable planting rain in the May-July period, and rainfall records show that while the average rainfall for these months is not high, the expectation of such rains is quite reliable.

It has been shown at Biloela, which is only one degree south of the Tropic of Capricorn, that a wheat crop averaging 38 bushels per acre could be grown on a nil effective rainfall subsequent to planting, when moisture had been conserved to a depth of four feet during the previous wet season.

Wheat.

Wheat is grown as the major annual crop on most of the large grain farms in the open plains and adjoining country of the Darling Downs. In other districts in which dairying and mixed farming predominate, the crop is grown in rotation with both winter and summer fodder and grain crops. Many years of continuous cultivation have shown that on flat land the practice of an annual crop of wheat following a short summer-autumn fallow has proved economically sound and has not been attended by any noticeable falling off in yields. Many Darling Downs farmers will alternate wheat only occasionally with another winter crop such as oats, linseed or canary seed, and switch to summer cropping for a few seasons only when winter weeds have become a major problem.

The old established practice has been to burn stubbles and to cultivate the land as soon as possible thereafter to allow of the maximum possible penetration of summer rains. This practice has already proved disastrous on much of the sloping land on the eastern and southern Downs, where heavy soil losses have occurred during recent years. In such areas soil conservation practices, including the greater use of summer cropping and the retention of winter crop stubbles, are being increasingly adopted. Stubble mulching is not, however, widely practised as yet, and much investigation into the practicability and the long-term effects of such methods will be necessary before they can be confidently recommended in the extensive grain producing areas of the relatively flat plain country.

Fallowing techniques made possible by modern power farming have definitely proved themselves insofar as yield is concerned, in spite of continuous use of the land under virtual monoculture. While commercial fertilizers as yet give no measurable response on most of the State's wheat lands, there is some indication (in the prevalence of mottling in normally vitreous grain) that the system in use is responsible for some

Plate 69.

Wheatfields at Charlton, near Toowoomba.

Plate 70.

Wheat on the North-western Portion of the Darling Downs.

Plate 71.

Trial Blocks of Wheat at the Department's Hermitage Regional Experiment Station, Southern Darling Downs.

general deterioration in quality. While yields are well maintained, however, there is little likelihood that farmers will make any attempt to modify what is now, and has been for many years, a very profitable system of farming.

Wheat varieties in common use are mainly those bred in Queensland or in the northern districts of New South Wales. Varieties from the southern States are not in general well adapted to Queensland conditions, being unreliable, particularly in the drier seasons. The State's wheat breeding programme was initiated before the close of last century by Mr. R. E. Soutter and carried on by him for fifty years before his retirement. The major characteristics of his varieties have been drought resistance (coupled with early maturity and light foliage development), high gluten quality, and more recently, resistance to both stem rust and leaf rust.

Recent modifications in the breeding programme have been necessitated by (i.) a change in the baker's flour quality requirements and (ii.) alterations in the stem rust flora.

With regard to quality, Queensland has in the past produced a high proportion of grain of high gluten strength but somewhat harsh character. Present demand is for a flour of lower gluten strength but better elasticity and general balance. Qualities of this type are being aimed at in future releases.

Changes in the stem rust flora have also complicated the breeding programme. During past years farmers have escaped heavy rust damage by the use of local rust-escaping wheats, and more recently by

the use of rust resistant varieties, a number of which originated in northern New South Wales. The recent occurrence of new biotypes of stem rust, coupled with an exceptionally wet season in 1950, showed most of the hitherto resistant varieties to be highly susceptible, and focussed attention on the necessity for new varieties resistant to the new rust biotypes. In each of the major changes in the rust flora during the last decade, it has been physiological resistance such as possessed by the Kenya varieties which has broken down in the presence of a more virulent rust biotype. Mature plant resistance of the Hope type has remained unaffected. Fortunately there has recently been liberated a new variety carrying the Hope type of resistance, and a second is ready for release during the current season. These varieties, in company with a number of unnamed hybrid selections, proved markedly superior to all other varieties under test during the trying conditions of the 1950 season.

While Queensland's wheat area has only in recent years been sufficient to supply the State's requirements, it has expanded considerably since World War II. and is capable of considerable further expansion, even within the existing wheat districts. Maximum annual production of 14,317,422 bushels was achieved in 1948 from an area of 607,750 acres at a mean yield of 23.6 bushels per acre. The State's mean yield per acre over the five-year period up to 1948-49 season was 20 bushels per acre, which is in excess of that for any other Australian State.

Other Winter Cereals.

In the districts under consideration, other winter cereals are of minor importance compared with wheat. Oats are grown mainly as a grazing crop for dairy stock, and to a lesser extent for hay and grain. This crop is therefore to be seen more frequently in the dairying districts of the eastern Downs and the Burnett and Callide Valleys than in the main grain districts of the central and northern Downs. The industry is based largely on varieties from southern States, but during recent years the development of crown rust resistant varieties has been given considerable attention. A little barley is grown, mainly for feed purposes, as local soil and climatic conditions are not conducive to the production of a high quality malting grain.

Linseed.

Linseed has been successfully introduced into the wheat growing districts, largely under the stimulus of commercial enterprise, and is grown under very similar conditions to those applied to wheat. The crop depends largely upon stored moisture for its growth requirements and is handled completely by regular wheat farm machinery. Under comparable conditions, yields are approximately two-fifths to one-third of those expected for wheat, but with existing world prices for the crop, returns compare more than favourably with those from wheat. While only one variety, Walsh, is as yet being grown commercially, it is possible that plant introduction and selection may provide additional varieties better suited to Queensland conditions. The main present establishment of the crop is on the Darling Downs, but successful crops have also been produced as far north as the Callide Valley.

Plate 72.

A Linseed Variety Trial at Hermitage Regional Experiment Station on the Darling Downs.

The Sorghum Group.

The principal summer crops associated with dry farming conditions in Queensland are those within the sorghum group—comprising grain sorghums, sweet sorghums, Sudan grass, and to a much smaller extent, broom millet.

Grain sorghums have occupied a major place in the dry farming scene since dwarf and double-dwarf varieties became available in quantity 12 years ago. A large number of varieties were introduced into Queensland during 1933 and carefully tested during the next few years. The best of the dwarf varieties were then liberated to farmers and a rapid annual increase in area took place until the peak year of 1946-47.

Plate 73.

A Crop of Dwarf Grain Sorghum.

Expansion of this crop was largely at the expense of maize in the drier dairying and mixed farming districts. Its two main advantages over maize were (i.) its greater drought resistance and (ii.) its ability to be harvested readily by existing (and widely distributed) wheat harvesting machinery.

While grain sorghum has been proven time and again to be a more reliable grain crop than maize in areas of irregular or marginal summer rainfall, it is by no means a certain grain crop even within the 25-30 inch rainfall belt (which provides a mean growing season rainfall of some 14-18 inches.) Crop failures within this zone have been quite frequent, particularly as one proceeds towards the present northern and western limits of cultivation. It has, however, been the invariable practice of dairy farmers to treat this crop as a dual purpose crop, harvesting the grain for the feeding of farm stock (mainly pigs) and using the stubble for grazing by dairy cows. This secondary utilisation of the crop has in fact frequently been regarded as of equal or greater value than that of grain production. Thus even crop failures may be turned to good account and may be the means of saving the lives of stock during periods of serious drought.

For this reason the yield of grain per acre by no means tells the whole story. While yields of 30 bushels per acre are normally expected under reasonable farming conditions, and 60 bushels per acre is often exceeded on good soils during favourable seasons, the State's average over a period of years is only a little in excess of 20 bushels per acre.

While the rainfall requirement of a reasonable sorghum crop has often been assessed at some 15 inches during the growing season, the figures will vary greatly from district to district and season to season, depending on such factors as evaporation, regularity of incidence, and degree of penetration into the soil.

Tabulated below are the rainfall records (December to April) for some ten seasons at Biloela Regional Experiment Station, together with general notings on the value of the season for sorghum production. It will readily be seen that growing season rainfall alone is not a good indication of crop success, without due cognizance of other factors.

BILOELA RAINFALL (POINTS).

Season.	Dec.	Jan.	Feb.	Mar.	Apr.	Dec.-Apr.	Crop response.
1941–42 ..	127	497	1,195	239	261	2,319	Good
1942–43 ..	467	280	477	105	57	1,386	Fair
1943–44 ..	447	235	804	47	73	1,606	Fair
1944–45 ..	299	506	198	130	80	1,213	Poor–Fair
1945–46 ..	350	699	49	96	5	1,199	Very poor
1946–47 ..	247	209	970	440	79	1,945	Poor
1947–48 ..	280	135	331	678	164	1,588	Poor
1948–49 ..	236	129	887	561	181	1,994	Good
1949–50 ..	103	347	814	266	252	1,782	Fairly good
1950–51 ..	119	643	271	48	16	1,097	Very good

The crop is generally sown by means of standard wheat drills with certain grain runs blocked to allow of row spacings of 14, 21 or 28 inches. In other districts maize planters may be preferred, in which case row

spacings are increased to 3 ft. or 3ft. 6 in. Where the wider row spacings are used, inter-row cultivation is necessary, but in closely spaced crops the operation is not required. Closely spaced crops run a greater risk of crop failure during stress periods than do those with wider row spacings, but may provide very heavy yields during seasons of ample and well distributed rainfall. Grain harvesting is carried out by means of standard harvesters with but minor adjustments to comb, drum, blast and riddles.

Breeding work in central Queensland has shown two main types of drought resistance—(*a*) that due to early maturity coupled with a low overall water requirement, and (*b*) that associated with later maturing varieties which may remain almost dormant during periods of stress, and recover well when the drought period is relieved. Varieties of type (*a*) do not possess the same powers of recovery as type (*b*) when effective rain falls following a dry heatwave period. In certain seasons, type (*a*) shows definite superiority while in others the situation is reversed. Since seasons cannot accurately be forecast, the farmers' best course is probably to rely upon two varieties of different maturity periods, or if a single variety is to be grown, to use an intermediate type such as Alpha.

The local breeding programme naturally has as a major aim the provision of varieties adaptable to the vagaries of the Queensland growing season. Other objectives have been (1) a uniform heading height suitable for mechanical harvesting; (2) more palatable and higher quality plant residues following harvesting; and (3) ability to escape damage by moth larvae in near-coastal districts. Not all of these attributes have been sought in the one variety as they are not all required for any one district. Some measure of success has been obtained, however, in all three aims by the development of (1) Alpha, a high yielding and uniform heading variety, (2) Capricorn, a grain variety with juicy (Kaffir-type) stems and leaf midribs, and (3) Coastland, whose very open panicles are unattractive to the yellow peach moth.

Among the sweet sorghums several good varieties which are capable of yielding 20-30 tons of green matter per acre are available. Such varieties may be used for cutting for either green feed or ensilage or may be grazed direct in the field. However, except where small subdivisions are used, direct grazing is particularly wasteful, and most efficient use is made of the crop by cutting and chaffing. On account of the higher labour requirement of this crop it is not grown to nearly the same extent as grain sorghum. Thus far more dairy cows in the drier districts of the State are fed on grain sorghum stubble than on sweet sorghum, in spite of the greater production per acre and higher palatability of the latter crop.

Sudan grass is widely grown as a summer and autumn grazing crop in the drier agricultural districts, and to a lesser extent for hay and ensilage. It provides a quick growing and very reliable grazing crop of one or two seasons' duration in such districts. While there is always a risk of prussic acid poisoning with the utilisation of this crop prior to the flowering stage, efficient grazing requires this risk to be taken. The risk becomes virtually negligible where (1) a reliable seed source free from Johnson grass and from sorghum hybrids is used, and (2) reasonable grazing precautions are taken. While HCN content

may vary widely with environmental conditions, definite evidence of the existence of low HCN strains has been obtained. A current breeding programme is now isolating and multiplying such strains with the aim of providing a variety which should be safe for grazing at all stages of growth.

Another group of summer crops which has been less widely used for grazing, hay and seed production is that known collectively as the millets. This group includes white panicum, Japanese millet, giant and dwarf Setaria and French millet. These crops, being of short duration, are useful and reliable dry district crops which might well find a greater use as cultivation is extended westward and northward.

Cotton.

Cotton is a crop which is in many ways well adapted to the dry-farmed districts of the State. The cotton plant is deeply rooted and possesses undoubted drought resistance. Under severe drought conditions, however, the plant survives at the expense of its crop, which is partially shed by the formation of abscission layers at the base of floral and fruiting pedicels. In spite of this the crop has played a major part in helping to establish farms in newly settled areas in central and sub-central Queensland. Cotton was frequently the initial cash crop planted on scrub burns and providing funds for the further improvement of farms and the purchase of dairy stock. With the establishment of stable dairying and mixed farming communities, however, cotton came to be relegated to the position of a subsidiary crop.

The peak season for cotton production in Queensland was 1938-39 when 12,447 bales of lint were produced from 41,112 acres. The serious decline which ensued has been variously attributed to the following causes:—(1) instability of the crop and frequent failures during dry seasons; (2) the susceptibility of the crop to insect pests; (3) the relatively higher and more stable returns obtainable from dairy products and pig meats; and (4) the dwindling away of the floating population previously available for cotton picking.

While (1) had some basis in actual experience, the fact remains that a few individual farmers did make comfortable incomes from cotton growing over a period of very indifferent seasons from 1941 onwards. Pest damage has been largely overcome by the use of power sprays and modern insecticides. The disparity in returns has been relieved to some extent by the provision of a much higher guaranteed price for local cotton. Finally, the introduction of mechanical harvesting has been attended with reasonable success, but as each harvester is capable of handling a limited crop each season, a considerable dollar expenditure would be entailed to provide sufficient machines even for the current annual crop of some 1,500 bales of lint.

Cotton could become a vital crop in the Australian economy; it has also been shown to be a useful crop in the individual farm economy, particularly in rotation with pasture leys. Its attainment of an important position must, however, rest upon its attractiveness to the farmer, and this in turn will depend upon (1) a possibly still higher price in comparison with competitive products, (2) greater use of mechanical harvesters and (3) the availability of cheap water for supplementary irrigation in suitable growing districts.

Plate 74.

A Modified Header Harvesting a Crop of Sunflowers on the Darling Downs.

Sunflowers.

Sunflowers grow well in the drier agricultural districts of Queensland, frequently providing yields of more than half a ton of seed per acre. The crop is comparable with grain sorghums in its water requirements, and recently gave promise of providing a useful additional source of oil for local industry. The growth of linseed production has probably had an adverse effect upon this crop, and recent market prices have not been sufficient to stimulate an increase in production. The crop may be sown either by maize planter or grain drill, and is harvested by means of headers equipped with shallow trays projecting in front of the comb to catch falling heads and seed. Both giant and dwarf varieties have been harvested satisfactorily by this means.

Legumes.

The major annual summer legume crop in the districts in question is the cowpea. While it is not used nearly as frequently as it might be as a green manure or grazing crop in rotation with cereals and pasture leys, recent high prices for the seed in sugarcane districts have stimulated its culture for seed production.

Soybeans have not been widely tried in these districts, mainly because of the absence in the past of an assured and profitable market. Suitable outlets for the crop are now more promising than at any previous period, and some development of the crop therefore seems assured. Considerable work has been entailed in sorting out introduced varieties and in selecting within the best of those available to develop strains suitable for direct harvesting under Queensland conditions.

Lucerne also has not been used to the fullest advantage. The districts in question are normally regarded by farmers as being too dry for satisfactory lucerne production except on alluvial flats where the

Plate 75.
A Lucerne Patch Used for Grazing Pigs.

water table it naturally high, or where irrigation is available. Much more of this country could and should grow lucerne as an integral phase in its cropping programme, particularly in association with dairying or with fat stock raising. Production would, of course, be mainly seasonal, where irrigation facilities are not available. Establishment would normally require a reasonable fallow period to build up subsoil moisture reserves and eliminate as many weeds as possible. Since lucerne effectively drains the moisture from a considerable depth of soil, old stands should preferably be ploughed out in the spring to enable adequate moisture replenishment before annual crops are reverted to. Lucerne could also be profitably used to a far greater extent than at present as a pasture component in these districts.

Future Developments.

Experience gained in the Callide and Dawson Valleys suggests that crop production alone could not be expected to be a profitable annual venture in any districts which are more marginal with respect to climate. Even in the Callide Valley, it is the animal industries (mainly dairying and pig raising) which have stabilised the local agriculture. Without livestock many farms in this district would have produced nothing of cash value during some of the semi-drought years between 1942 and 1948. With livestock, no grain or legume crops are total losses, since crop failures can be used as grazing crops during drought periods.

It would appear, therefore, on the basis of present knowledge, that any further agricultural developments in such areas should be regarded as subsidiary to animal production. Sudan grass could be used to a much greater extent both for grazing and for hay. Grain sorghums could also be grown annually to provide in good seasons both grain for storage and stubble for grazing, and in bad seasons crop grazing alone.

As one proceeds northwards and westwards between the 20-inch and 30-inch isohyets the rainfall of course becomes less effective on account of higher evaporation rates. This would be counteracted to some extent by the fact that the rainfall becomes still more seasonal until, in the Gulf country, it is restricted almost entirely to the summer monsoon periods. Where suitable arable soils exist, therefore, the opportunities appear good for large scale development of the sorghum and millet groups as useful adjuncts to the beef cattle industry.

At present, the Callide and Dawson Valleys would appear to approach the northern limits of successful wheat culture. The main limiting factors to further northward expansion would be (1) the more seasonal incidence of the rainfall, and (2) the higher day temperatures, causing higher evaporation and transpiration rates.

In the latitude of the Darling Downs, considerable westward expansion is possible for both summer and winter crops. For the latter, two main requirements would be (1) reasonably level country, and (2) soils which are retentive of moisture and therefore suitable for fallowing. The lighter soils would in general be better suited to summer cropping. Wheat has for many years been successfully produced in small pockets as far west as Roma, while sorghums and Sudan grass have also successfully invaded this area. In this direction, however, as well as in the north, best prospects of a stable agriculture would undoubtedly require crop production to be allied to animal production. Virtually all crops grown under such a system would then be regarded as triple purpose crops to be switched to seed production, hay production or grazing according to the requirements of the season.

Junior Farmers' Organisation.

New clubs have been formed during the past few weeks at Kingaroy, Childers, and Pomona. Club officials appointed were as follows:—

Kingaroy—Club Leader, Howard Goodger; Deputy Leader, R. Hetherington; Hon. Secretary, Hugh Goodger; Hon. Treasurer, W. Liesegang.

Childers—Club Leader, John Bunn; Deputy Leader, H. Bonnano; Hon. Secretary, Alf. Plath; Hon. Treasurer, Gordon Eastaughffe.

Pomona—Club Leader, John Hancox; Deputy Leader, Des. Hawken; Hon. Secretary and Treasurer, Miss June Napier.

Clubs in the Warwick, Chinchilla, Murgon, Wondai, Maryborough, Gayndah, Monto, and Callide-Dawson Valley areas again staged either competitive or non-competitive exhibits at local shows this year to date, winning many awards and highly complimentary references from judges and show visitors alike.

Their members also accepted positions as honorary assistant stewards in the various agricultural sections, such services being greatly appreciated by the various societies concerned.

In the North quite a number of clubs arranged junior farmer displays at the various shows—Bowen, Mackay, Ayr, Home Hill, Tully, Innisfail, Cairns, Malanda, and Atherton.

The societies in these areas include in their prize schedules judging contests covering dairy stock, fruit, tomatoes, cane, and vegetables, open to members of junior farmer clubs only. This is creating much interest among clubs generally and has attracted a large number of entries in most cases.

Three boys from the clubs in the Mackay district recently won an agricultural "quiz," conducted over the air from the Mackay broadcasting station, winning a fortnight's free tour of northern areas as far as Mossman and the Atherton Tableland, the various junior farmer clubs at the centres visited acting as "host" to them. The winners of this contest were T. Lawrie (Sarina club), D. Madden (Racecourse Mill), and Reg. Renton (North Eton).

Soil Factors Affecting Crop Production in Queensland.*

W. G. WELLS, Director of Regional Experiment Stations.

THIS somewhat vague title has been chosen to allow me to tell you something of the various soil problems which have been encountered in crop production in south-eastern and central Queensland. Although the investigations of these problems have been mainly associated with cotton, it is felt that the problems apply to most crops grown in the 25-40 inch rainfall districts of this State.

The investigations have been conducted at the experiment station which was established at Biloela in the Callide Valley in Central Queensland in 1924. This district, in which large areas had been resumed from cattle stations for closer settlement, had produced very satisfactory yields of cotton in exploratory plots conducted by the Department of Agriculture and Stock. Characterised by a rainfall of approximately 28 inches and soils of high fertility contained in a wide valley floor with long low slopes on each side, this district was considered likely to become the largest cotton growing district in the State. Accordingly investigations in cotton growing occupied an important place in the early programme of the station.

At first good yields were obtained on the newly cleared land and the cotton area in the district rapidly expanded to between 30,000 and 40,000 acres. With repeated cropping to cotton for several seasons, however, yields declined on nearly all types of soils unless exceptionally regular rainfall was experienced throughout the growing season.

On the experiment station, areas that produced up to 1,700 lb. seed cotton per acre in the first year of cultivation out of virgin grassland, after four or five years of successive cotton crops could not be relied upon to produce over 500 lb., and on certain soil types not over 300 lb., per acre.

As the usual laboratory analyses of these soils had shown them to be well supplied with the major plant foods it was realised that a normal type of nutrient deficiency was not contributing to these irregular results. Accordingly the nitrate-nitrogen† content of the soils was systematically studied in cultivations of various ages. It was found that, whereas in a new cultivation out of virgin grassland the top six inches of soil seldom contained more than 15 parts per million during the growing period of the cotton, old cultivations contained regularly up to 40 or 50 p.p.m. at a period when the cotton plants were in the transitional period of development from the vegetative phase to the fruiting phase. Some of the most fertile soils contained as much as 90 p.p.m. at this stage in the plants' development.

The effect on the type of plant produced on soils with such a difference in nitrate-nitrogen content is most interesting. Usually in the first season of cultivation after virgin grassland the plants develop an open type of structure which is characterised by a reddish-brown main stalk, light yellowish-green leaves of tough texture, and usually a good crop of bolls if ample soil moisture is available at critical periods.

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* This paper was presented to the Agriculture and Forestry Section at the Brisbane Meeting of the Australian and New Zealand Association for the Advancement of Science.

† This is nitrogen available to growing plants and results mainly from the breaking down of organic matter by soil micro-organisms.

The plants on the same soil after three or four repeated croppings to cotton become increasingly more vegetative in structure, with a coarser main stalk characterised by a dark greenish-brown colour and much axillary leafage and large dark-green main leaves of a thin texture. Obtaining good yields from such plants depends on very favourable conditions being experienced.

The first year crop does not appear to be very attractive to the major pests which attack cotton in this State, but if some of the flower buds or fruit are destroyed the plants continue to set a crop efficiently. The plants on the older cultivations, however, delay the setting of the first flower buds and if these are lost early in their development very rank growth of the plant usually develops under conditions of ample moisture. Such plants are very sensitive to irregular climatic conditions and with their high rate of transpiration react very quickly to even short periods of high temperature, thereby causing further shedding of young flower buds.

With the loss of a boll crop to utilise most of the uptake of nutrients the plants are in a very vulnerable condition. Owing to the high potential rate of nitrification in old cultivations, wet periods favour the development of such a supply of nitrate-nitrogen that the plant's uptake is sufficient to promote a rank growth which approximates a prolongation of the vegetative phase rather than the fruiting phase. Consequently in some seasons little or no crop is developed until late in the season when a combination of reduction in temperatures and hardening of plant growth may promote the formation of a late top crop under favourable moisture conditions.

Value of Grassland Rotation.

It became obvious, therefore, that a reduction in the nitrate-nitrogen content of the top soil during the critical stages of growth of the cotton plants was necessary if good yields of cotton were to be regularly obtained. Various crop rotations embracing combinations of cotton and crops requiring considerable nitrogen, such as grain sorghum, sweet

Plate 76.

Rhodes Grass Deterioration After Six Years.—The pasture was laid down on soil of moderate fertility. The outside of the pasture block, adjoining cultivated areas, shows green and tall growth. Away from the edges production is very low.

Plate 77.

Rhodes Grass in its Second Year of Establishment after Three Years of Cotton Cultivation.

sorghum, wheat, oats, maize and Sudan grass, were tried without obtaining any results that promised a solution of the problem. It was then decided to put the cultivations back into grassland to see if the original satisfactory conditions could be duplicated. Rhodes grass, which was performing satisfactorily in the district on newly burnt-off scrub country, was selected for the trial and proved to be highly suitable.

After two years of establishment of a pasture of this species it was found that the following cotton crop developed a structure comparable to that obtained in the first year after virgin grassland and that the nitrate-nitrogen content of the soil under this crop was very satisfactory for cotton production. Much work has since been done to elaborate the use of the cotton-grassland rotation and it is now recommended that for most soils the Rhodes grass pasture be established for four years followed by four annual croppings in this order—cotton, grain sorghum, cotton, and in the fourth year cotton if the previous crop has indicated that the nitrate-nitrogen moisture balance is satisfactory. If not, cowpea is used for repeated grazing during the fourth season and Rhodes grass is then resown in the following early summer.

Importance of Subsoil Moisture for Cotton.

In the course of the investigations it was noticed that two factors appeared to have a very important effect on the type of plant and crop produced when cotton was grown on old fertile cultivation. Plantings in late September and October in time-of-planting experiments consistently outyielded November and December plantings. Also, in seasons experiencing above-normal rainfall either during the late winter or in the early stages of the growth of the crop, plant development tended to resemble the desirable fruiting type produced following pasture. Systematic samplings indicated that in both the early plantings and under early wet conditions the nitrate-nitrogen content of the soil during the vegetative phase of the development of the plants was so low as to promote only a slow tough type of growth which quickly changed over to the fruiting phase. The early setting of a crop of flower buds resulted in the utilising of the uptake of nitrogen sufficiently to maintain a favourable carbon-nitrogen ratio in the plants for the rapid formation of further flowers and bolls, provided ample moisture was available.

The investigations in the nitrate-nitrogen content of the soils were co-ordinated with the soil moisture studies and the results indicated clearly the value of having ample subsoil moisture at planting time in the Station's immature alluvial soils with moisture equivalents ranging from 22 to 38 per cent. for the top 12-18 inches of soil. During the first two seasons out of virgin grassland the permeability of this zone of soil was suitable for obtaining penetration of most types of rain, but from then on the deterioration of the structure of the surface soil brought about by ploughing and the maintenance of clean inter-tilled row crops progressively reduced the ability of these soils to absorb satisfactorily, after they were compacted with the season's cultivations, any but steady soaking rains. Determination of the percentages of water-stable aggregates of various sizes confirmed this loss of structure in the surface soils. Comparisons of adjacent virgin grassland and aged cultivations indicated that in 19 years of continuous row-tilled cropping the percentage by weight of water-stable aggregates greater than seven-tenths of a millimetre declined from 48 to 25 per cent. Dry sievings of the surface soils at the end of the cotton crop also showed how this loss of suitable crumb structure contributed to a consolidation of the surface layers, and in some seasons following early storm rains the top caked half-inch of soil after row cultivation ceased obviously prevented the penetration of much of the first part of each storm rain experienced.

This loss of permeability in the top layer of the soil is of the utmost importance in Central Queensland. Approximately 50 per cent. of the year's rain occurs in the period December to March. This summer rainfall is characterised by mostly storm type of precipitation in which the first part of the storm is featured by hard driving large drops which churn the surface of row-tilled and clean fallowed areas into a thin paste which clogs up the pores of soils of poor structure.

The 12-year means of rainfall records of the experiment station indicate that during October to January inclusive over 41 per cent. of the rainfall for each of these months occurred at the rate of ·75 inch or more per hour, and that in all rainfall exceeding ·10 inch per hour 50-75 per cent. of the total rain of the average storm of this type occurred in the first third of the individual storm time. Runoff must therefore be excessive on all but flat land if the structure of the surface layer is poor, and actually a 4½-inch intense thunderstorm failed to penetrate more than four inches in the top soil under a cotton crop on a slight slope of an old cultivation.

When it became apparent that with the deterioration of the structure of the surface soils greater emphasis should be placed on conserving the subsoil moisture resulting from the penetration of the main wet season rains, cropping rotations were tested with this objective. An annual summer hay crop which could be mowed in time to prevent the crop using the subsoil moisture, followed by ploughing and leaving the land fallow until spring for cotton, seemed the most likely rotation. This cropping provided ample subsoil moisture but the bare fallow increased nitrification and gains in cotton yields were obtained in only very dry years, with appreciable losses in seasons which were favourable for a high rate of nitrification.

In devising the 8-year cotton-grassland rotation provision was therefore made for ploughing out of the grassland at the end of the wet season before the grass had used the lower subsoil moisture and for

including grain sorghum as the crop in the second cultivation to enable ploughing to be done before the late autumn and winter rains. The main weakness of this rotation is that if cotton follows cotton in the fourth year after a dry winter insufficient subsoil moisture may be encountered to carry a big crop through an irregular season.

Improving the Soil Structure.

The use of Rhodes grass pasture not only provides a suitable nitrate-nitrogen environment for the following cotton crop but materially restores the soil structure, as evidenced by the following sievings of water-stable aggregates of a size greater than $\frac{1}{4}$ mm.:—

Continuous cotton—0–6-inch zone, 28 per cent.; 7–12-inch zone, 58 per cent.

After 3 years Rhodes grass—0–6-inch zone, 41 per cent.; 7–12-inch zone, 66 per cent.

This partial restoration to the normal 48-50 per cent. of water-stable aggregates in the top six inches of soil in the virgin grassland of the experiment station increases the penetration of storm rains. An inch of rain will not penetrate more than six inches of the station soils in the first year of cultivation when the moisture content is at wilting point and not over five inches in old cultivations under row-tilled crops after they have been compacted following the planting operations. Consequently, even with rains approximating 2 to $2\frac{1}{2}$ inches, frequently only 35 per cent. of the rainfall is trapped in old cultivations under cotton compared with upwards of 70 per cent. for cotton on first or second year cultivation after grassland.

This deterioration of soil structure is not confined solely to continuous cotton cultivation. In one investigation over a 15-year period, in which wheat for hay was planted repeatedly on the same site in rotation with a summer green manure crop of annual grasses or cowpeas, the loss of organic matter and soil structure eventually resulted in the surface soils setting so hard, if storm rains occurred before the cowpea seedlings were well established, as to prevent the satisfactory growth of the cowpea. Yields declined also in the wheat crops, though comparisons of analyses of these soils and adjacent virgin grassland did not show any significant differences in their nutrient status. Likewise a rotation of annual cropping embracing cotton alternating with first grain sorghum and then wheat for grain failed to maintain the soil structure satisfactorily in a soil with a moisture equivalent of approximately 26 per cent., as evidenced by the following wet sieving results:—

Virgin grassland—0–6-inch zone, 50 per cent. aggregates $\frac{1}{4}$ mm. and larger.

Cotton, grain sorghum, cotton, wheat, &c.—27 per cent.

Cotton continuously for 9 years—14·5 per cent.

Cotton on Dairy Farms.

The use of pasture leyland in the cropping programme fits in well in the economy of the average farm in the 25–40-inch rainfall belt of this State. On most farms some form of animal husbandry is practised, with pastures often occupying a large proportion of the farm, particularly in the drier districts in which dairying is extensively practised.

Undoubtedly the productivity of these pastures can be markedly improved by ploughing them out and cultivating the land for suitable annual cropping for at least four years prior to re-establishing the pastures. The cultural operations associated with the annual cropping will assist in the decomposition of the roots and stubble of the grasses, thereby releasing nutrients which will materially increase both yields and quality of the following pastures. At Biloela the decline in a single-species pasture, such as Rhodes grass pasture, is most pronounced, yields falling from 3 to 2½ tons of air-dried hay in the first or second year to as low as 6 cwt. in the sixth year of establishment. During this period the crude protein content at correct hay stage may range from 12 to 8 per cent. in the first or second year to as low as 4 to 3½ per cent. in the sixth year. It is necessary, however, not only to maintain the cultivation of annual crops long enough to restore a satisfactory nutrient status for the new pasture, but also in the last year before re-establishing the pasture to grow a crop that will not retard the processes of nitrification.

This is evidenced by the results obtained in an investigation into the merits of row cultivated Rhodes grass conducted at Biloela. The basal layout of the experiment was a series of pairs of plots in which on one plot of each pair three successive crops of cotton had been grown while the companionate plot had been left in virgin grassland.

After a good seed-bed had been prepared over the whole area following ploughing and short fallowing of the grassland plots, a comparison of row cultivated and broadcast Rhodes grass was sown in each plot. Yields at hay stage and analyses of samples of the hay indicated that for five years starting in 1939 the plots following cotton outyielded each season those following virgin grassland, and the strip cultivated plots except in one wet season outyielded the broadcast plots.

Subsoil Moisture for Cereals.

The investigations conducted on the experiment station have also shown that it is advisable to have ample subsoil moisture at planting time of both grain sorghum and wheat. Table 1 presents the yields obtained in a grain sorghum varietal trial conducted over three seasons.

TABLE 1.

GRAIN SORGHUM VARIETAL TRIALS.

Variety.	Bushels per Acre.			—	Rainfall (inches.)		
	1949.	1950.	1951.		1949.	1950.	1951.
Alpha ..	39·5	30·7	82·4	Planting to flowering ..	1·39	4·47	9·06
Wheatland ..	40	28·4	81·4	Flowering to maturity ..	14.48	10·80	1·75
Ajax.. ..	46	32·5	75·7	Depth of wet soil at planting	54	30	45
Capricorn ..	39	33·6	74·9				
Caprock ..	46·7	37·1	73·2				
Kalo.. ..	40·5	33·2	71·1				
Early Kalo ..	42·1	30·2	68·6				
Means ..	42	32·2	75·3				

Comparing the means of 1949 and 1950, it will be noted that in spite of the low rainfall in 1949 during the period from planting to flowering, all varieties produced a satisfactory average yield.

In contrast, in 1950, with only 30 inches of wet soil at planting the same varieties, experiencing over twice as much rain to flowering and good rain after that to maturity, produced only 76 per cent. as much grain on the average. The value of the combination of good depth of wet soil at planting and ample well distributed rainfall to the flowering period is well illustrated by the high average yield obtained in 1951 under conditions of very low rainfall from flowering to maturity.

In contrast to these illustrations of the need for both good subsoil moisture at planting and timely rainfall during the period of flowering of a summer crop like grain sorghum, Table 2 is presented to indicate how a winter grown crop like wheat can produce satisfactorily under a small amount of rainfall during the growing period provided ample soil moisture is available at planting.

TABLE 2.

Wheat Varietal Trials.

Variety.	Bushels per Acre.			—	Rainfall (inches.)		
	1948.	1949.	1950.		1948.	1949.	1950.
Gabo ..	37·4	39·7	40·0	February to planting ..	18·54	17·97	15·58
Puno ..	42·1	37·5	34·2	Date planted	30–6	6–6	2–6
Pusa 4 ..	38·8	34·3	41·2	June rain after planting	Nil	·10	2·12
Seafoam ..	34·2	33·4	31·8	July rain	1·62	·64	2·82
Puora ..	38·1	33·0	34·8	August rain	Nil	·08	1·32
Charter ..	39·7	31·9	35·1	September rain	·41	·96	1·09
Means ..	38·4	34·7	36·2	Depth wet soil at planting	48	42-48	40
				Average height	33·6	31·5	50·7

Comparing the mean yields of 1948 and 1949, it can be seen that the combination of 48 inches of wet soil and two inches of rain during the growing period supplies about the minimum amount of moisture required to produce good yields. Comparing these two years with 1950 indicates clearly, however, that plant type plays an important part in the water requirements of wheat under Queensland conditions. Although 7·35 inches of rainfall was well distributed during most of the growth of the crop, the markedly larger and more vegetative plants reacted sufficiently to dry conditions during the latter half of September to prevent four out of six of the varieties equalling their yields of 1948.

Summary.

Summarising briefly, the findings of the investigations conducted at Biloela indicate that in the 20-40 inch rainfall districts of south-eastern and central Queensland, rotations should be practised embracing:—

(1.) Short-term pasture leylands to conserve the soil, to maintain its structure and fertility and to provide grazing and fodder for live stock.

(2.) Cropping programmes which maintain a suitable plant food-moisture relationship for pastures and annual crops. The inclusion of a short fallow at periods which will allow of the conservation of sufficient soil moisture to provide a "season" in the ground at planting, to supplement the rainfall during the growth of each crop, should be a routine feature of such programmes.

ANIMAL HEALTH

Grass Tetany or Oat Tetany.

D. W. LAVERS, Assistant Veterinary Officer.

GRASS tetany, also known as lactation tetany, oat tetany and grass staggers, is a highly fatal disease of cattle and cattle owners are advised to be on the alert for its appearance and prepared to carry out treatment should it occur. The disease usually makes its appearance in winter or spring when seasonal conditions are favourable for rapid growth of fodder crops, particularly oats, and winter pastures.

Most cases occur two weeks after stock have been turned on to lush new grazing but some cases have been seen on average natural pasture.

The stock affected are usually well-conditioned milking cows calved one to six weeks, but the disease may occur later in lactation. Other types of cattle, including dry cows, calves, steers and bulls of both dairy and beef breeds, are occasionally affected.

How Cattle become Affected.

Although the disease frequently occurs with the first flush of spring growth, its cause is not known. It is known, however, to be non-infectious. A marked fall in the magnesium content of the blood occurs and this is often accompanied by a fall in the calcium content.

Of the theories advanced so far, none has been adequately proven. It has been suggested that a deficiency of magnesium in the young grass might be important in causing the condition, but this seems unlikely in view of the fact that animals may become affected when the diet is adequate in magnesium.

Symptoms.

The main feature of the disease is nervousness and excitability. This may take the form of an unsteady gait, rolling of the eye, an anxious or wild appearance, frothing at the mouth, salivation, twitching of the muscles and sometimes aimless or excited charging regardless of any obstacles in the path. Affected animals after a time stagger and frequently fall to the ground. In the more acute cases convulsions are seen, the animals showing periods of stiff extension of the limbs (tetany) for approximately half a minute followed by bouts of paddling movements lasting about a minute. Death may occur at the end of an hour, or the animal may lapse into a coma lasting several days and ending in either death or complete recovery. In very acute cases, the animal may be found dead without any previous symptoms having been seen.

In all except the mildest cases, the milk yield is decreased and the animal is disinclined to eat. The temperature may be raised to 104 or 105 deg. as a result of any unusual exertion.

Occasionally the symptoms shown are similar to those of milk fever, leading to some confusion of the two conditions. It should be remembered, however, that milk fever usually occurs within four days after calving while grass tetany seldom appears before the second week after calving. In milk fever dullness and prostration are the characteristic features, whereas in grass tetany nervous excitement is the rule.

On post-mortem examination very careful observation is required to detect any departure from normal. In some cases dark patches beneath the skin and in the muscles along the back and over the shoulders, suggestive of blackleg, may be seen, but there are no bubbles of gas present. There is usually mild inflammation of the fourth stomach and small intestine and there may be small haemorrhages in the spleen and heart muscle.

Treatment.

Since a marked fall in the magnesium and often the calcium content of the blood occurs in this disease, the aim in treatment is to counteract this fall by providing the animal with magnesium and calcium, thus returning the blood levels to normal. The dose is 1 oz. of Epsom salts (magnesium sulphate) dissolved in three to four fluid ounces of water, which is then filtered through a thin mat of cottonwool placed in a funnel, boiled and allowed to cool to blood heat. This may be injected under the skin behind each shoulder, a portion at each of three or four different points. A more efficient method is to inject the solution directly into the blood stream by way of the jugular or mammary vein, but this operation is of course more difficult to perform. Drenching with 1 oz. of Epsom salts in one quart of water, with 2-3 lb. molasses added, is useful in the absence of an injection, but is dangerous to use in the more severe cases, as drenching may bring on a convulsive attack, allowing the solution to enter the lungs and cause pneumonia. For this reason drenching must be carried out with the greatest care at all times.

If the beast fails to respond to the Epsom salts treatment, calcium borogluconate should be given in the same manner as in the treatment of milk fever. Sufficient water is added to 2½ oz. of calcium borogluconate to make 12 fluid ounces of solution, which is then boiled, cooled to blood heat and injected either under the skin or into the blood stream as before.

When an outbreak occurs a change of crop or pasture should be effected immediately if possible; otherwise handfeeding should be adopted, using hay or silage, until the outbreak has ended.

Prevention.

Outbreaks of this disease may be avoided if care is taken in the management of the pastures or grazing crops during the period of the year when they are likely to cause trouble. If possible, do not graze young cereal crops until the period of rapid growth is over. If young, rapidly growing crops must be fed, bring cattle on to them gradually and provide some other feed of a more fibrous nature. Handfeed with hay or graze the animals in an old grass paddock (or harvested corn paddock if available) in the early part of the day and turn them on to the crop in the later part of the day when the sun has been out for some time.

Although grass tetany is not regarded as a deficiency disease caused by lack of magnesium in the diet, there is some evidence that outbreaks may be prevented by increasing the intake of magnesium. Dolomite (a mineral containing both calcium and magnesium) may be used as a pasture topdressing, or it may be given in the feed at the rate of about 2 oz. per week for each cow or added to a hay, silage or concentrate mixture at the rate of 3-5 lb. per ton.

Since this disease is often rather difficult to diagnose accurately, and since treatment by an inexperienced person may lead to serious after-effects, a veterinary surgeon or Inspector of Stock should be contacted when grass tetany is suspected.

Contagious Vaginitis of Cattle.

D. N. SUTHERLAND, Divisional Veterinary Officer.

INFERTILITY in cattle or failure to reproduce at regular intervals is a cause of serious economic loss in many dairy herds in this State. There are numerous factors which may be responsible for infertility, important among these being infections of the reproductive organs, deficiencies in the diet and hereditary factors. Unfortunately, our knowledge of all the factors which may be responsible for infertility is as yet incomplete.

In the type of infertility encountered most commonly in dairy herds in Queensland, cows come on heat regularly but fail to conceive to repeated service by the bull. There is still a considerable difference of opinion amongst veterinarians as to the factors mainly responsible for sterility of this nature. Some hold the view that the majority of such cases are due to the effects of contagious or granular vaginitis, and in support of this view the argument is advanced that treatment for vaginitis will in many cases eliminate the trouble. Those who disagree with the theory that vaginitis is a serious cause of infertility contend that the value of treatments given in these cases is often greatly exaggerated, as infertility of this nature is generally only temporary in any case and recovery ensues in the majority of cases without treatment, especially if service is withheld for six to nine weeks.

The term vaginitis means inflammation of the vagina, which in the case of cattle is a passage approximately ten inches in length, separated at its forward end from the womb by the cervix and opening to the exterior behind through the vulva. In contagious or granular vaginitis the inflammation is present mainly just inside the vulva.

Cause and Spread.

The actual cause of contagious vaginitis has not been established yet, although it is almost certainly due to infection by a micro-organism. The disease can be reproduced artificially by transfer of material from the vulva of an infected cow to the vulva of a normal cow. In such cases the typical lesions of the disease generally appear in about five to ten days.

Under natural conditions the main method of spread appears to be from cow to bull and vice versa by service. In addition it may be spread by failure to observe proper precautions when examining or treating cows; for example, examining the vulva of a number of cows

without sterilizing the instruments. As lesions of the disease are also encountered in virgin heifers it must be assumed that the disease may also be spread by other means as yet unexplained.

Symptoms.

The lesions produced by this disease are quite characteristic and are readily recognised by opening the vulva with the fingers and examining the mucuous membrane. In the early, acute stages of the disease the mucous membrane is swollen and inflamed and studded with numerous dark red nodules approximately one-tenth of an inch in diameter. These nodules are generally confined to the lower portion of the vulva and vagina and they tend to be arranged in longitudinal rows. At this stage of the disease there is usually a clear mucous discharge which mats the tuft of hairs situated just below the vulva. In addition, the cow may show some uneasiness and pass water more frequently than usual. This stage of the disease generally lasts for about one month, after which time the inflammation subsides and the nodules become paler in colour although they persist for some months.

The inflammation of the vagina is generally aggravated by service and for some days after service the inflammation appears much more severe. When affected cows are withheld from service, or if they become pregnant, the inflammation generally subsides more quickly.

The disease may affect bulls as well as cows and in such cases lesions similar to those in the vulva and vagina are seen on the penis and in the sheath. The lesions in the bull are generally less severe than in cows.

Effect on Breeding.

The general effect of vaginitis in the herd is to prevent conception in a high proportion of the cows affected. As it spreads throughout the whole herd fairly rapidly, it can cause serious interference to the breeding programme for a period of some months. There is no evidence that vaginitis can cause abortion or interfere with the regularity of heat periods and if such symptoms occur in the herd it should be suspected that some other condition, such as brucellosis or malnutrition, is present. Infection with vaginitis does not have any marked effect on the fertility of the bull. However, if the infection is present in the herd for any length of time the bull would naturally be overworked and his fertility would tend to be lowered from this cause.

Preventive Measures.

In view of the serious interference to the fertility of the herd which this disease can cause, farmers should pay particular attention to means of preventing its introduction, and if it is introduced, to controlling its spread through the herd. Care should be taken when purchasing cows to examine them for the presence of vaginitis. The herd bull should be kept in a paddock on his own and cows brought to him for service rather than allow him to serve cows in the herd at random. In addition, precautions should be taken to prevent strange bulls from having access to the herd.

If the disease does become established in the herd all cows should be withheld from service for a period of at least three weeks. The whole herd, including the bull and heifers over six months of age, should be treated for the disease. If examinations of a number of cows

are made to determine whether the disease is present the hands should be washed in a suitable disinfectant solution before each cow is examined.

Treatment.

The condition generally responds fairly well to treatment and a large number of preparations have been used with a fair degree of success. It is of the utmost importance that when treatment is undertaken very strict precautions should be taken to prevent the spread of the disease or the introduction to the genital organs of other pathogenic bacteria on the instruments used in the treatment. The majority of treatments recommended involve the use of solutions for douching out the vagina, and for this purpose either a one-pint brass syringe or a funnel to which is attached a length of rubber tubing should be used. If a syringe is used at least two nozzles should be provided so that each nozzle can be placed in a suitable disinfectant solution between cows. Similarly, if a funnel is used several lengths of rubber tubing should be provided.

Satisfactory results have also been reported from the use of various dusting powders and where these are used a rubber bowl to which is attached a solid nozzle is used for blowing the powder into the vagina. A number of short lengths of rubber tubing should also be provided in these cases so that a freshly disinfected one can be used on each cow. In addition to taking precautions to sterilize instruments, the area surrounding the external genital organs and the tail should be thoroughly washed with a disinfectant solution before treatment is given.

The treatment which has been generally recommended for this condition in Queensland and found to be satisfactory is douching of the vagina every second day for three weeks with approximately 1½ pints of a 0·3 per cent. solution of zinc sulphate. To make up this solution one ounce of zinc sulphate should be dissolved in two gallons of water. For ease of handling a stock solution of 10 ounces of zinc sulphate in one quart of water can be made up and then one fluid ounce of this solution added to half-a-gallon of water to make up the solution required for treatment.

In addition to the zinc sulphate treatment satisfactory results have been reported from the use of the following preparations:—

(1) Zinc sulphocarbolate 0·1 per cent. solution—douche with 1½ pints twice a week for three weeks.

(2) Lugol's iodine and glycerine, equal parts—syringe out with one ounce twice a week for three weeks.

(3) Silver picrate 1 per cent. in kaolin, as dusting powder—5 gm. three times weekly for three weeks.

(4) Acriflavine 1:1500 solution—syringe out with about one-third of a pint twice a week for three weeks.

It must be recognised that these treatments are effective only against vaginitis and of no use in cases of infertility due to other causes. Should infertility persist after treatment has been given the advice of a veterinary surgeon or Inspector of Stock should be sought without delay.

Brucellosis Testing of Swine.

The Department of Agriculture and Stock is operating a scheme whereby pig herds are tested at intervals for the occurrence of swine brucellosis (contagious abortion).

A herd listed by the Department as ''brucellosis tested'' is one in which all such animals as may be determined by the Director of the Department's Division of Animal Industry have been subjected to two successive tests for brucellosis, at intervals determined by him, without any positive reactors being found.

In order for a herd to be retained on the list of Tested Herds, a semi-annual or annual re-test of the herd, as determined by the Director, is required. If at a re-test any animal gives a positive reaction to the test the herd is removed from the list; it is not listed again until subsequent tests, as determined by the Director, have been carried out.

Full particulars of the Brucellosis Testing of Swine and application forms may be obtained from the Under Secretary, Department of Agriculture and Stock, William Street, Brisbane.

TESTED HERDS.
(AS AT 10th JULY, 1951.)

Breed.	Owner's Name and Address of Stud.
Berkshire	S. S. Ashton, " Scotia " Stud, Pittsworth
	J. J. Bailey, " Lucydale " Stud, East Greenmount
	S. Cochrane, " Stanroy " Stud, Felton
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	G. Handley, " Handleigh " Stud, Murphy's Creek
	J. L. Handley, " Meadow Vale " Stud, Lockyer
	R. G. Koplick, " Melan Terez " Stud, Rochedale
	H. V. Littleton, " Wongalea " Stud, Crow's Nest
	O'Brien and Hickey, " Kildurham " Stud, Jandowae East
	E. Pukallus, " Plainby " Stud, Crow's Nest
	G. C. Traves, " Wynwood " Stud, Oakey
	E. Tumbridge, " Bidwell " Stud, Oakey
	Westbrook Farm Home for Boys, Westbrook
	H. W. Wyatte, Rocky Creek, Yarraman
	H.M. State Farm, " Palen Creek," Palen Creek
	A. R. Ludwig and Sons, " Cryna " Stud, Beaudesert
	H. H. Sellars, " Tabooba " Stud, Beaudesert
	F. Thomas, " Rosevale " Stud, Beaudesert
	Bowkett and Meacle, " Myola Vale " Stud Piggery, Burra Burri, Jandowae
	D. T. Law, Trouts Road, Aspley
	R. J. McCullough, " Maxholm " Berkshire Stud, Gatton
	C. F. W. and B. A. Schellback, " Redvilla " Stud, Kingaroy
Large White	H. J. Franke and Sons, " Delvue " Stud, Cawdor
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	F. L. Hayward, " Curyo," Jandowae
	J. A. Heading, " Highfields," Murgon
	K. B. Jones, " Cefn " Stud, Pilton
	R. G. Koplick, " Melan Terez " Stud, Rochedale
	R. Postle, " Yarralla " Stud, Pittsworth
	E. C. Smith, " Smithfield " Stud, Coomera
	E. J. Bell, " Dorne " Stud, Chinchilla
	A. G. Fry, " Birubi " Stud, Dalby
	M. E. Myers, Halpine Plantation, Kallangur
	L. C. Lobegeiger, " Bremer Valley " Stud, Moorang, via Rosewood
	J. H. G. Blakeney, " Talgai " Stud, Clifton
	V. P. McGoldrick, " Fairymeadow " Stud, Cooroy

TESTED HERDS—continued.

Breed.	Owners Name and Address of Stud.'
Tamworth	S. Kanowski, " Miecho " Stud, Pinelands
	N. R. Potter, " Actonvale " Stud, Wellcamp
	D. F. L. Skerman, " Waverley " Stud, Kaimkillenbun
	A. C. Fletcher, " Myola " Stud, Jimbour
	L. C. Lobegeiger, " Bremer Valley " Stud, Moorang, via Rosewood
	P. V. Campbell, Lawn Hill, Lamington
	Salvation Army Home for Boys, Riverview
	F. Thomas, " Rosevale " Stud, Beaudesert
	A. J. Surman, Noble Road, Goodna
Wessex Saddleback	W. S. Douglas, " Greylight " Stud, Goombungee
	K. Day and P. Hunting, " Kazan " Stud, Goodna
	E. Sirrett, " Iona Vale " Stud, Kuraby
	C. R. Smith, " Belton Park " Stud, Nara
	H. H. Sellars, " Tabooba " Stud, Beaudesert
	H. Thomas, " Eurara " Stud, Beaudesert
	D. T. Law, Trouts Road, Aspley
	G. J. Wilson, " Glenbella " Stud, Silverleigh

NEW DAIRY FARM COMPETITIONS.

Changed conditions and an increase in prize money to £2,420 are features of the Queensland Dairy Farm Competitions for 1951-52 to be conducted by the Department of Agriculture and Stock.

The important changes made should create greater interest in the competitions, which are financed from the Commonwealth Dairy Industry Efficiency Grant. One of the main changes is that this time, in addition to the whole farm competition in each zone, there will be six sectional zone prizes. The whole farm competition prizes remain at: 1st, £50 and trophy; 2nd, £30 and pennant; 3rd, £20 and certificate. The sectional prizes in each zone are: 1st, £15 and pennant; 2nd, £5 and certificate, and will be awarded for each of the following aspects:—Efficiency of land usage, farm buildings (farm layout and machinery), dairy buildings (layout and equipment), herd management, farm economy, and animal feeding.

To be eligible for a sectional prize the farm must be entered in the whole farm competition, and if a farm is of sufficiently high merit it will be possible for it to carry off all first prizes in the zone, totalling £140.

Another important change is that the number of zones has been reduced from 16 (as in previous competitions) to 11. This re-arrangement of boundaries of dairying districts should provide keener competition for the increased prize money.

Times of judging of the farms in the competition have been reversed. The first judging will now take place in the late spring or early summer, and the second (final) judging in the late summer or early autumn. This change has been made to fit in with seasonal conditions. It will mean that field days, at which the benefits of the competitions can be passed on to farmers generally, can be held within about a month of the final judging instead of four or five months later as in the past.

Entries, which are free, will close with the local officer of the Department on 31st August. The competitions are open to all dairy farmers except those who are co-operating with the Department in the demonstrations financed from the Commonwealth Grant. Farms conducted by Government institutions or subsidiaries are also ineligible. Competitors who gain prizes in the 1950-51 competition, still to be decided, will be handicapped.

ASTRONOMICAL DATA FOR QUEENSLAND.

SEPTEMBER.

Supplied by W. J. Newell, Hon. Secretary of The Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			MINUTES LATER THAN BRISBANE AT OTHER PLACES.					
Day.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	6·03	5·33	Cairns	27	31	Longreach ..	34	36
6	5·58	5·36	Charleville	27	27	Quilpie	35	35
11	5·52	5·38	Cloncurry	48	52	Rockhampton ..	9	11
16	5·46	5·40	Cunnamulla ..	29	29	Roma	17	17
21	5·40	5·42	Dirranbandi ..	19	19	Townsville ..	22	27
26	5·35	5·45	Emerald	18	20	Winton	38	42
30	5·30	5·46	Hughenden ..	33	37	Warwick	3	4

TIMES OF MOONRISE AND MOONSET.

At Brisbane.

Day.	Rise.	Set.
	a.m.	p.m.
1	5·46	5·17
2	6·16	6·13
3	6·46	7·10
4	7·16	8·09
5	7·47	9·10
6	8·23	10·13
7	9·03	11·20
8	9·51	..
		a.m.
9	10·46	12·27
10	11·49	1·31
	p.m.	
11	12·57	2·31
12	2·07	3·23
13	3·15	4·08
14	4·21	4·48
15	5·24	5·23
16	6·25	5·55
17	7·25	6·26
18	8·25	6·59
19	9·25	7·33
20	10·24	8·10
21	11·22	8·50
22	..	9·36
	a.m.	
23	12·17	10·26
24	1·08	11·19
		p.m.
25	1·54	12·15
26	2·35	1·12
27	3·12	2·09
28	3·45	3·06
29	4·15	4·03
30	4·46	5·00

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

Charleville 27; Cunnamulla 29; Dirranbandi 19;
Quilpie 35; Roma 17; Warwick 4.

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Day.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	14	23	30	39	5	14	34	45
6	26	12	42	27	17	2	49	30
11	30	9	45	24	20	0	53	26
16	18	19	34	35	9	10	38	40
21	9	30	35	44	0	20	26	53
26	11	28	26	43	0	19	28	51
30	18	19	34	35	9	10	38	40

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	18	38	42	56	27	41	16	33
3	28	26	50	47	34	33	24	22
5	40	15	57	41	42	26	33	14
7	51	5	65	34	49	20	42	6
9	56	2	68	32	52	17	46	3
11	54	3	67	32	51	18	44	4
13	44	11	61	38	45	23	37	11
15	33	23	52	45	37	30	27	20
17	20	34	44	54	29	39	18	29
19	10	45	37	60	22	46	9	37
21	3	53	34	66	18	51	4	44
23	2	56	33	67	17	53	3	46
25	5	52	35	65	19	50	5	44
27	11	45	38	60	23	46	10	37
29	21	34	44	54	29	39	18	29
30	27	29	48	50	33	35	22	25

Phases of the Moon.—New Moon, Sept. 1st, 10.49 p.m.; First Quarter, Sept. 9th, 4.16 a.m.; Full Moon, Sept. 15th, 10.38 p.m.; Last Quarter, Sept. 23rd, 2.13 p.m.

Equinox.—On Sept. 24th at 7 a.m., the sun will cross the Equator on its apparent journey from north to south and on this day the sun will rise and set at true east and true west respectively. On the 16th and 30th the moon will rise and set at true east and true west approximately.

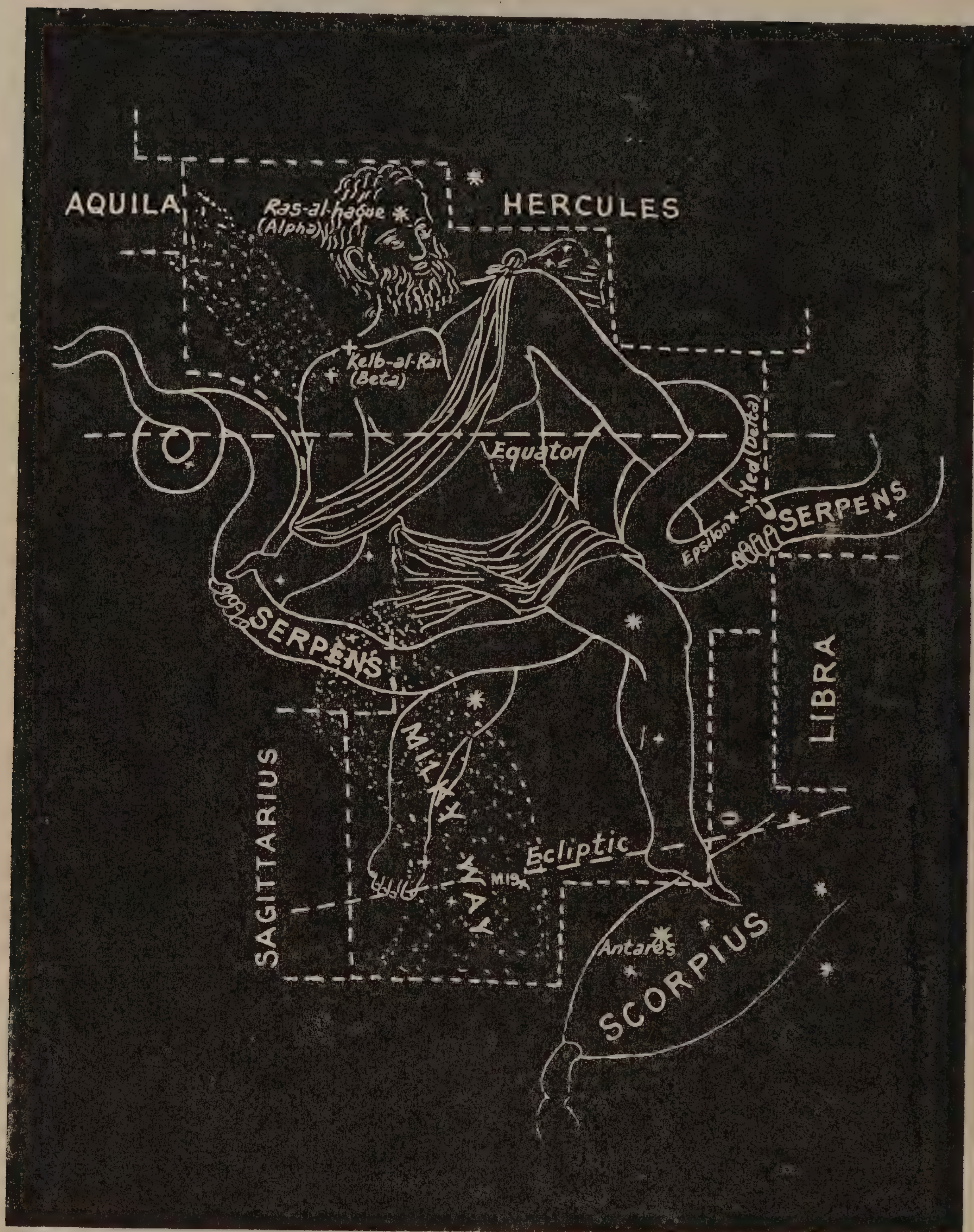
Mercury.—Will be a morning object all this month. On the 1st, in the constellation of Leo, will rise about 15 minutes before the sun and on the 16th will reach greatest angle west of the sun when it will rise ¾ hour before sunrise. By the end of the month it will rise 23 minutes before the sun.

Venus.—Also in the constellation of Leo. At the beginning of the month will be too close in line with the sun for observation but by the end of the month it will rise 2 hours before sunrise. However, it should not be confused with Mercury and Mars, which are both much fainter than Venus.

Mars.—In the constellation of Cancer at the beginning of the month but by the end of the month will be in the consetellation of Leo, close to Venus. It is, however, much fainter and redder than Venus.

Jupiter.—Favourably placed for observation almost throughout the whole night, in the constellation of Pisces. On the 1st it will rise between 8 p.m. and 9.15 p.m. and at the end of the month will rise just before sunset.

Saturn.—May be observed low in the west near sunset at the beginning of the month but by the end of Sept. it will be too close in line with the sun to be seen.



THE CONSTELLATIONS.

OPHIUCHUS.

Adjoining Scorpius, on the north-east is the constellation of Ophiuchus, one of the largest groups in the sky, part being north of the Celestial Equator and part south. Though it is not listed as one of the Zodiacal constellations, the sun and planets pass through quite a large portion of Ophiuchus between the constellations of Scorpius and Sagittarius. In fact, there is a far larger portion of the Zodiac in **Ophiuchus** than in Scorpio.

The group is said to represent the mythological God of Healing, Aesculapis, and on old star maps the god is shown with one foot on the Scorpion (Scorpius) and holding a large serpent in his hands. The constellation Serpens is curiously mixed up with Ophiuchus, and appears both east and west of it.

Though Ophiuchus is a large constellation it is not easily defined and contains no very bright stars, but a branch of the Milky Way extends into the southern portion of it and there are some very fine objects to be seen with optical aid, including double stars, clusters, &c.

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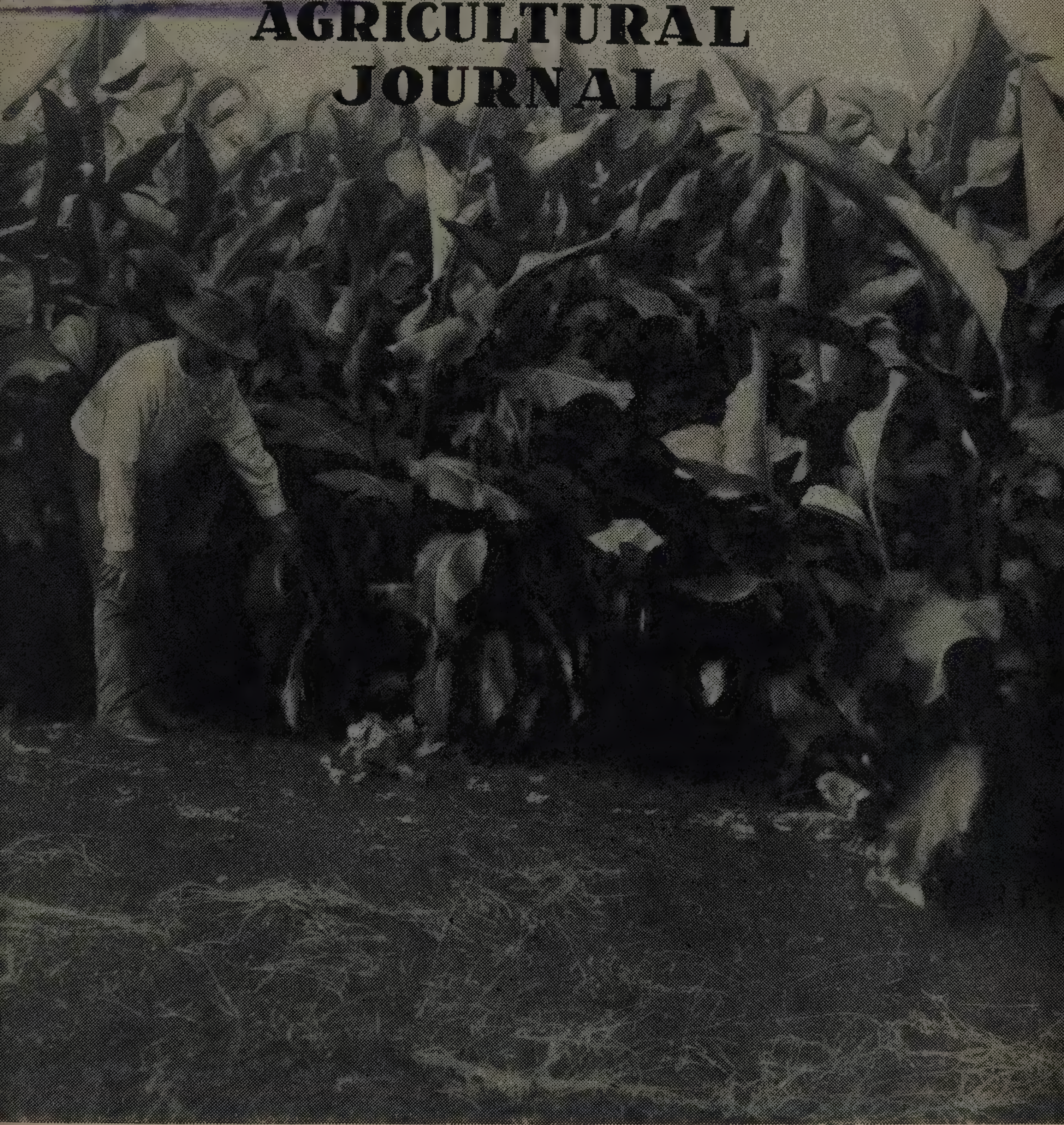
SEPTEMBER, 1951

DEPARTMENT OF AGRICULTURE

AUDAX AT FIDELIS

QUEENSLAND AGRICULTURAL JOURNAL



An Arrowroot Crop on the South Coast

LEADING FEATURES

Broom Millet

Milking Machine Operation

Horticulture in the Dry North

Infectious Calf Pneumonia

Baconer Carcass Competitions

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C. W. WINDERS, B.Sc.Agr.

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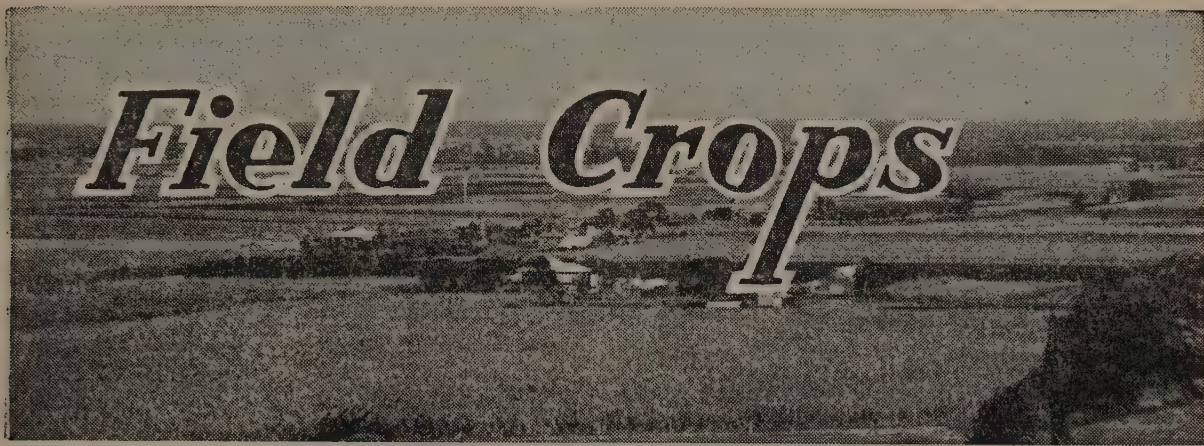


Broom Millet.

R. E. HASELER (Adviser in Agriculture) and W. G. STEELE (Senior Adviser in Agriculture).

BROOM millet belongs to the non-saccharine types of the group of plants classified as sorghums. The production of heads having long branches which form brushes is the outstanding characteristic of broom millet, or broom corn as it is called in the United States of America. The origin of broom millet is not clear but it is known to have been grown in Europe for more than 300 years.

The long fine branches of the brush or panicle are the commercial portions of the broom millet plant, although the seed threshed from the heads is useful as feed and the stalks have some fodder value as roughage for cattle. Good quality brushes are uniform in size, length, elasticity and toughness and are of a nice bright colour free from blemishes. The brushes are used almost exclusively for the manufacture of various types of brooms.

Broom millet growing is a comparatively minor primary industry in Queensland. In the 1936-37 season, 776 acres were cultivated to this crop, but since then there has been a more or less steady decline, and in 1949-50 only about 200 acres were cropped.

The attitude of farmers in the past has no doubt been considerably influenced by the fact that demand in Australia was limited and the market was sometimes over-supplied by growers in New South Wales. As the crop is grown under non-irrigated conditions, seasonal vagaries have caused fluctuations in yields and returns to growers. Prevailing prices have not been competitive with prices from other primary products and consequently farmers have not exhibited any great interest in expanding acreage in Queensland.

However, the stage has been reached at which supply is much below demand, and if the high average price in 1951 for broom millet brushes (in excess of £150 per ton of fibre) is maintained, there is every indication that very profitable returns can be obtained from the crop.

Soil Requirements.

Broom millet can be grown with some degree of success on a variety of soil types, but for reasonable assurance of good returns, fertile soils, such as the alluvial loams and clay loams (Plate 78), are essential. For best results growth of the plants needs to proceed without check from the seedling stage right through to time of maturity of the brush.

Plate 78.

A Broom Millet Crop at Moogerah, Boonah District.

In the broom millet growing districts, there is a tendency to relegate the crop to sites of lower fertility and to reserve the more fertile areas for such crops as maize, potatoes, onions, lucerne and pumpkins, which, as a rule, are more profitable than broom millet. In common with other members of the sorghum group, broom millet can withstand dry conditions better than most of the crops just mentioned, hence farmers are influenced to sow it on the slopes and poorer soils where other crops will not usually yield profitably. In such soils, however, soil moisture fluctuates more sharply than in the fertile alluvial loams and clay loams; consequently the yield and quality of broom millet brushes produced on the slopes and the poorer soils may vary appreciably from season to season depending on rainfall. There is no doubt that more fertile soils should be selected for the growing of broom millet if its production is to be placed on a really satisfactory basis.

On some farms, however, it may be necessary to sow broom millet on the slopes so that the more fertile soils can be devoted to the production of fodder crops for livestock. In such cases a suitable rotation should be adopted to increase the fertility of the soil on which the broom millet is to be grown, and to improve its capacity to absorb storm rains and retain soil moisture.

In considering suitable rotations it should be remembered that broom millet is a member of the sorghum group of plants and should therefore not follow sorghums or Sudan grass. Root crops and legumes such as lucerne, cowpea and field pea are suitable crops to precede broom millet.

The use of leguminous crops, such as cowpea in the summer and field pea in the winter, as rotation crops on broom millet land is strongly recommended. If practicable it is desirable to plough the whole crop in as a green manure.

Where good land management methods are followed, the chances of obtaining satisfactory returns from broom millet under a wide range of climatic conditions will be greatly enhanced.

Preparation of the Seed-bed.

The methods employed in the preparation of a good seed-bed for the sowing of maize are suitable for broom millet also. Because of the necessity of preventing, as far as possible, any check in the growth of the broom millet plant, all practical methods of building up moisture in the subsoil before planting should be followed.

Where planting is to be done in the early spring, the land should be ploughed in the autumn and left in a rough condition so that the winter rains may be trapped efficiently. Sufficient harrowing and, if necessary, discing should be done through the late winter to control weed growth, and to firm the seed-bed gradually in time for early planting.

For the crop sown in mid-season, the land should be ploughed in the spring and left in a rough state to absorb the rain from early summer storms. Every effort should be made to eradicate weed growth and prepare a weed-free seed-bed, so that the broom millet seedlings will not have to compete with weeds for the available soil moisture and plant nutrients.

Varieties.

The variety of broom millet generally grown in Queensland is White Italian. It is suited to the soils of either the alluvials or the slopes, although there are marked variations in the yields obtained on the two types of soils because of differences in fertility and moisture-holding capacity.

Because of the necessity of producing brushes of high quality to obtain the best possible market price, it is advisable to plant the best seed obtainable. Where it is not convenient for a farmer to select seed from good types for his requirements, it is advisable for him to apply to the Broom Millet Board for his seed.

To maintain a high standard of broom millet, however, it is suggested that the grower inspect his crop before harvesting and select and mark plants showing desirable characteristics, which should be left for seed collection at a later date. In making selections the following points should be kept in mind:—

(*a*) Plants should be healthy with no discoloration on the stalks.

(*b*) Brushes should be of good length, straight, and with even fibres.

(*c*) Colour should be light and even.

(*d*) Seed should be well formed and light in colour.

Planting.

The planting period for broom millet varies according to the district in which the crop is to be grown. It is essential to have fine weather during harvesting, consequently sowings should be arranged so that the crop will be ready for harvesting at a time when weather conditions are likely to be favourable.

In the Lockyer Valley and adjacent districts, where most of the broom millet produced in this State is grown, there are, however, two well-defined planting times—August and September for an early crop, and early December for a late one. Crops planted during these months can generally be harvested in more satisfactory weather than is usually the case with plantings made in other months between these planting periods. Moreover, they have a much better chance of experiencing good growing conditions. Broom millet producers in the Lockyer Valley area should plant the early crop on the higher warmer slopes, and the late crop on the more moisture retentive soils of the lower slopes.

Broom millet is sown with one- or two-row maize planters equipped with plates to sow at the desired spacing of the plants. Usually the rows are spaced 3½ feet apart, but the plant spacing within the rows varies with the time of sowing.

Generally, the rate of sowing is adjusted to produce a stand to suit the soil type concerned and the time of planting so that there is a reasonable chance of a good crop without any thinning of the plants being necessary. As the plants of the early sown crops tend to tiller more than those of the later sowings, a rate of sowing is used in August and September which will space the plants 12 to 15 inches apart. For later planted crops, a heavier rate of sowing, which will leave the plants roughly nine inches apart, is used. The rate of sowing varies from 2 lb. per acre for the early sowing to as much as 5 lb. for the later plantings.

Cultivation.

The usual methods of cultivating maize are satisfactory for broom millet. The maintenance of clean cultivation in a broom millet crop is particularly desirable, as competition with weed growth for moisture and nutrients during any adverse growing periods seriously affects the growth of the broom millet plant. This applies particularly during the stage of development of the plant prior to the emergence of the brushes, for favourable growing conditions are essential then for the production of brushes of satisfactory quality.

Head Bending Operations.

The brush of broom millet grows very rapidly under favourable conditions, frequently reaching a length of 30 inches on fertile soils. The weight of the seed tends to cause the brush to spread out and the fibre may be bent or even broken if there are strong winds, resulting in poorer quality brushes. Any danger of harmful effects on the fibres of the brushes because of the weight of the seed can be largely overcome if the brushes are bent over so that the weight of the seed will keep the fibres hanging straight downward and close together.

The brushes are bent over when the weight of the seed becomes sufficient to cause spreading of the fibres. The operation is done during the hot, sunny part of the day by bending the stalk at a point about 12 inches or more (depending on the height of the crop) below the base of the brush, taking care to bend between the joints or nodes of the stalk. The usual procedure is for the operator to hold one arm up in the air with the wrist against the stalk and with the other hand to bend the stalk down around the wrist, thus preventing the stalk being broken or bent at too sharp an angle (Plate 79).

Plate 79.

Bending Broom Millet Heads by Hand.

This bending operation is a general practice in some broom millet producing countries, such as the United States of America, and could with advantage be practised in Queensland more widely than it is, especially where broom millet is grown on a soil fertile enough to produce a rapid growth of the brushes after good soaking rain. However, the amount and cost of hand labour required is a problem under present day conditions and it is doubtful if the gain in quality obtained by the practice offsets the extra work involved in the bending operation.

Attempts to reduce the amount of hand work have led to the development by a Boonah farmer of a method which is claimed to have given satisfaction. The method consists of rolling down the stalks prior to removing the heads. This operation is very effective and is carried out simply by attaching a fairly heavy pole, long enough to cover four rows, to the rear of a truck or tractor, which proceeds up the central two rows (Plate 80). Some stalks may be partly levelled by the vehicle and the whole row is flattened by the roller. The result is that the stalks and heads are all left lying in the same direction.

This facilitates harvesting and little, if any, damage is done to the heads. Only sufficient rows for the day or half day are levelled so that there is no danger of a sudden storm spoiling the brushes on the ground.

Plate 80.

Rolling Down Broom Millet with a Heavy Pole Attached to a Truck.

This facilitates removal of the heads.

Harvesting.

The best time for harvesting is when the brushes are well developed but while the fibre still has a nice green tinge, though starting to dry out. This stage in the development of the plant is reached before full maturity of the seed is attained, and sound judgment is required to make the right decision as to the suitability of the crop for harvesting.

In some seasons, an excessively wet period may make it necessary to harvest earlier than usual in an attempt to save clean heads that otherwise may be affected by moulds induced by the wet conditions. Again, in crops in which the heads have not been bent over, severe winds may cause splitting open of the supporting sheath of the brush, thus making it necessary to harvest as soon as possible in order to prevent bad distortion of the fibres of the brush. The inexperienced grower of broom millet would be well advised to consult an officer of the Agriculture Branch of the Department or an experienced grower, preferably in his own district, about any of the abovementioned harvesting problems, for by doing so serious losses may be avoided.

In cutting off the brushes, the operator grasps the brush with one hand and cuts through the stalk six inches below the brush with a pruning knife, cane knife or similar cutting instrument (Plate 81). With a little practice it is possible to remove the top of the sheath

Plate 81.
Cutting the Brushes from Rolled Stalks of Broom Millet.

surrounding the stalk below the head at the same time as the cut is made. This allows the brush stalk to dry out more rapidly and makes handling easier. The harvesting should be done on days of bright sunshine in hot, dry weather in order that the curing will be quickly accomplished.

Curing.

For curing, the cut brushes are spread out on a platform or table of stalks, which, after being headed, have been pulled over for the purpose; or, where the rolling down method has been used, on frames erected close to the barn or storage shed (Plate 82). Care must be taken to keep the brushes off the ground so that they may dry out quickly and uniformly. If wet weather threatens, it is necessary to gather the brushes and spread them under cover, as rain may discolour them and cause the development of moulds. Generally, if harvesting is done in hot, dry weather the brushes are cured sufficiently in several days to allow of their being gathered for the removal of the seed.

Where the curing is done under cover, it will be found that the colour and quality of the brushes are better than in brushes cured in the field. The cut brushes are first left in the field for a couple of hours to allow some evaporation of moisture to occur, after which they are loosely stacked, about three inches deep, on racks under cover. They should be turned at frequent intervals to hasten drying out and also to prevent the occurrence of heating in any dense brushes. Where curing is done properly under cover, a tough green brush free of discolouration results; this, if of proper length, commands top prices.

Plate 82.
Sun-curing Broom Millet Brushes.

Removal of the Seed.

The seed of broom millet is removed by holding the brushes against the rapidly revolving studded drum of a machine commonly called a hackler (Plate 83). The studs or spikes projecting from the drum strip or beat off the seed from the fibres without damaging the latter; in using the hackler the drum should revolve away from the operator. Either hand or power-driven machines may be purchased for this purpose.

Plate 83.
Removing Seeds from Broom Millet Brushes with a Power Driven Hackler.
An exhaust fan in the drum on the left removes the dust and trash from the revolving drum. The drum and frame covers were removed before taking the photograph.

Yields.

Yields may vary considerably depending on seasonal conditions and the soils used. Up to 15 cwt. of clean marketable brush per acre may be obtained on good soils but on poor soils 5 cwt. per acre may not be exceeded. Statistics show that the Queensland average is about 5 cwt. of marketable fibre per acre.

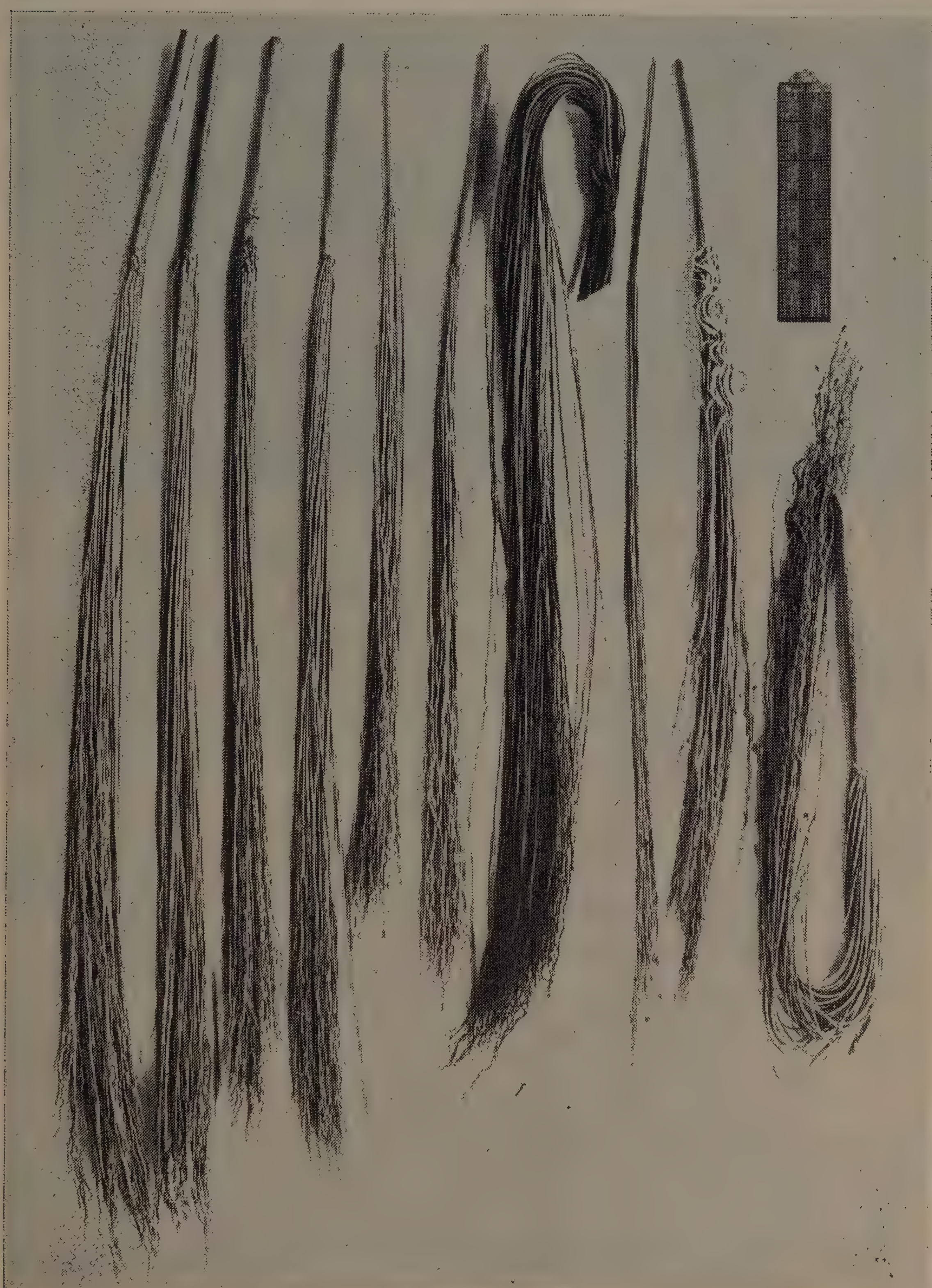


Plate 84.

Good and Poor Types of Brush. In sequence from the left are two brushes classed as hurl, two as covers, two as inside, and four inferior or unsuitable.

Grading.

The classing of broom millet brush into several grades for market is just as important as it is for any other farm product and therefore should not be overlooked by growers. Consideration must be given to trade requirements to ensure that material suitable for manufacturing is marketed.

The sorting of the brush into various grades is a simple, straightforward procedure which is based on colour, straightness and length.

Colour is defined as being green or golden; the former usually results when the crop has been harvested at an immature stage—that is, when the seed is in a milky or soft dough condition. The golden colour normally occurs when the crop is allowed to mature for a few weeks longer and the seed is firmer.

Straightness is important and only brush in which the fibres are relatively straight are acceptable. All very curly, broken, twisted, bent, mouldy, discoloured or other undesirable types of brush should be discarded.

Length is classed into grades as follows:—

(*a*) Short, up to 15 inches;

(*b*) Medium, 15 to 20 inches;

(*c*) Long, over 20 inches.

These various grades are known within the trade as inside, cover and hurl respectively (Plate 84), according to the use to which each grade is put in the manufacture of brooms.

Preparation for Market.

In Queensland the standard of preparation of broom millet brush for market still leaves much to be desired in many instances. The product should not be submitted for sale in an ungraded and poorly baled condition. Brush which is suitably graded and baled always attracts the buyers' attention and the extra work entailed is usually well rewarded by the higher prices received.

Various bales, showing the manner in which some broom millet is marketed in Queensland, are pictured in Plate 85. Unsuitable packages quite often range in size from 40 lb. bundles or trusses to bulky bales of over 250 lb. weight. Irregularly shaped and indifferently prepared bales present considerable difficulties in handling and storage.

The various grades of the differently coloured brushes should be baled separately in an ordinary hay press or in a similar type of press. In placing the brushes in the press care should be taken to protect the fibres. The best procedure is to place first a thin layer of the brushes flat in the bottom of the press, with all the butts of the brushes facing to one end of the bale. Another thin layer should then be placed on top of the first layer, with the butts facing to the opposite end of the bale, and with the fibres overlapping those of the previous layer. This process is repeated until the press is filled for the compressing of the finished bale. The bales are usually tied with three strands of No. 10 gauge wire. It is advisable also to use cross strands of soft tie wire to prevent the two outside wires from slipping off the bale. The size of the bale varies according to length of brush and type of press used, but one 40 inches long, 16 inches wide, and 24 inches deep, weighing from 100 to 112 lb., is very satisfactory for transport and storage.

Plate 85.

Good and Poor Bales. A good bale is standing on the box in the centre; the other bales are poor.

In Plates 86 and 87 are diagrams which illustrate a type of press used for making bales of this size. It can be constructed simply and cheaply from materials usually found on a farm and is easy to operate.

Briefly, the brush is placed in parallel layers in the press in the manner already described and compression is obtained by means of a lever manually operated in a see-saw fashion by two persons, the fulcrum bolt being lowered as the bulk is compacted.

When the material is sufficiently pressed, the three No. 10 gauge galvanized tie wires are placed in position and fastened. The completed bale is finally removed by unhinging the outer side of the press.

Marketing.

All broom millet produced in Queensland is required to be marketed through the Broom Millet Marketing Board. This Board, which operates under the *Primary Producers' Organisation and Marketing Acts*, 1926 *to* 1946, was originally constituted on 11th March, 1926, and has been in continuous operation since that date.

The Board itself does not handle the commodity, but has appointed as selling agents State Produce Agency Pty. Ltd., Brisbane, and Denham Bros. (Rockhampton) Pty. Ltd., Rockhampton. Growers must consign their broom millet to one of these agents, who, after deducting

5 per cent. of the proceeds of sales to cover the Board's administrative expenses, and a further 5 per cent. for agent's commission, remits the net proceeds direct to the growers. Bales are required to weigh no more than 1 cwt. each.

Each season, the Board requires a return to be completed by all growers, setting out the acreage planted and the expected crop. The Board normally sends forms for completion to all known growers, and in addition advertises its requirements in certain newspapers which circulate in the main broom millet growing areas. Generally, these forms are required to be returned during the month of February.

Anyone contemplating growing broom millet who wishes to obtain any further information on marketing should address communications to The Manager, Broom Millet Marketing Board, C/- Council of Agriculture, 369 George street, Brisbane.

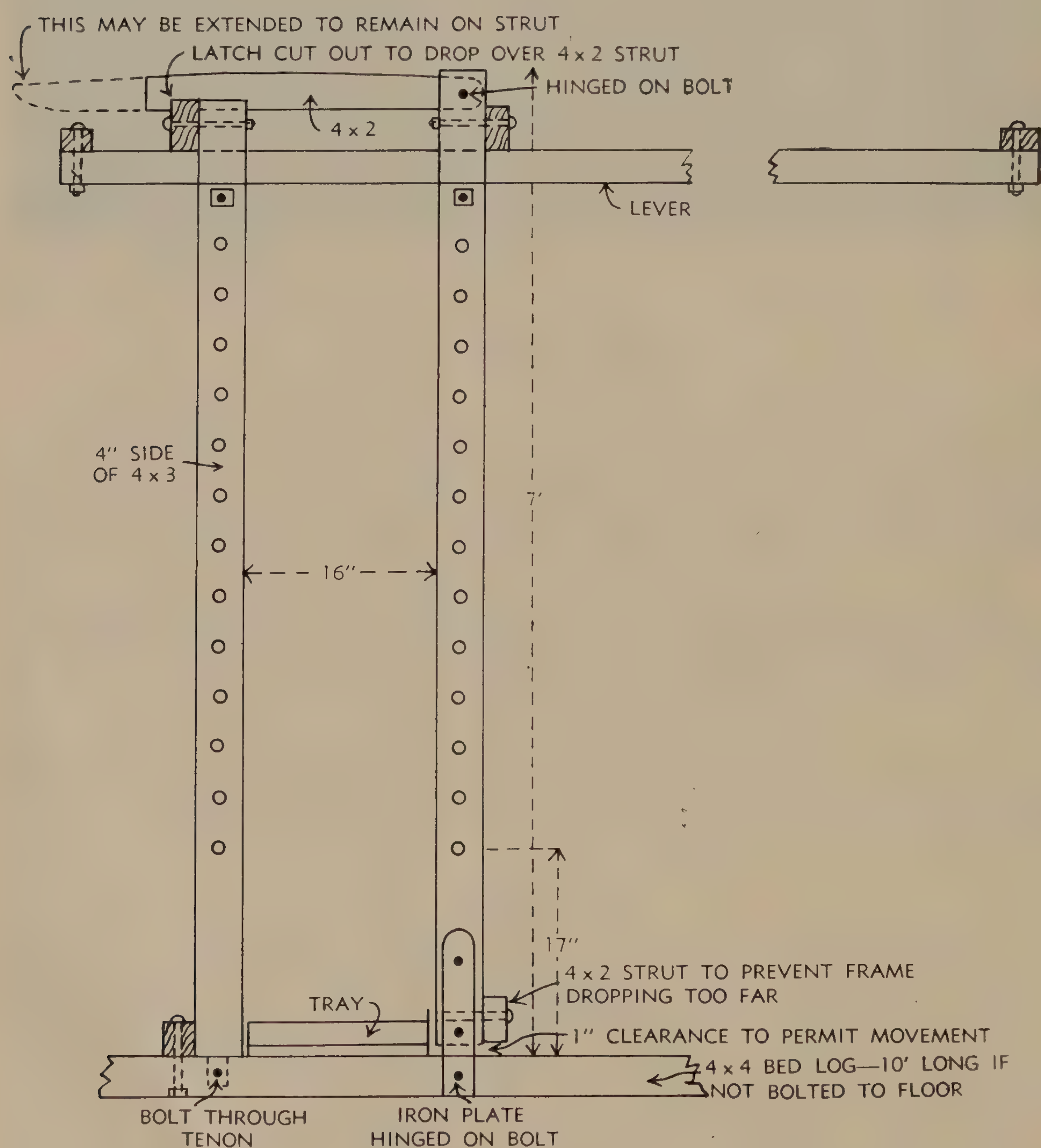


Plate 86.

Diagram of a Broom Millet Press (end view).

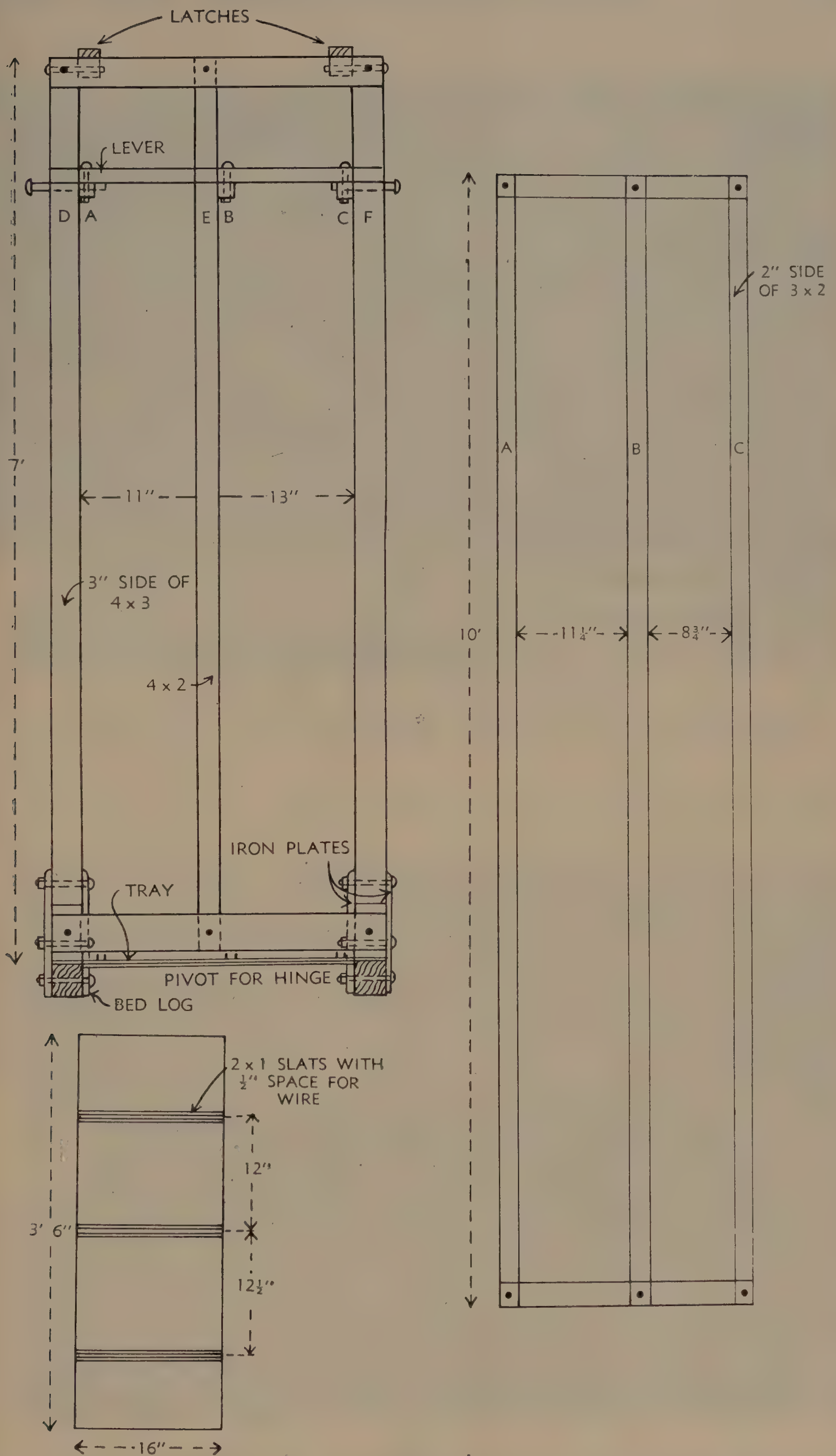
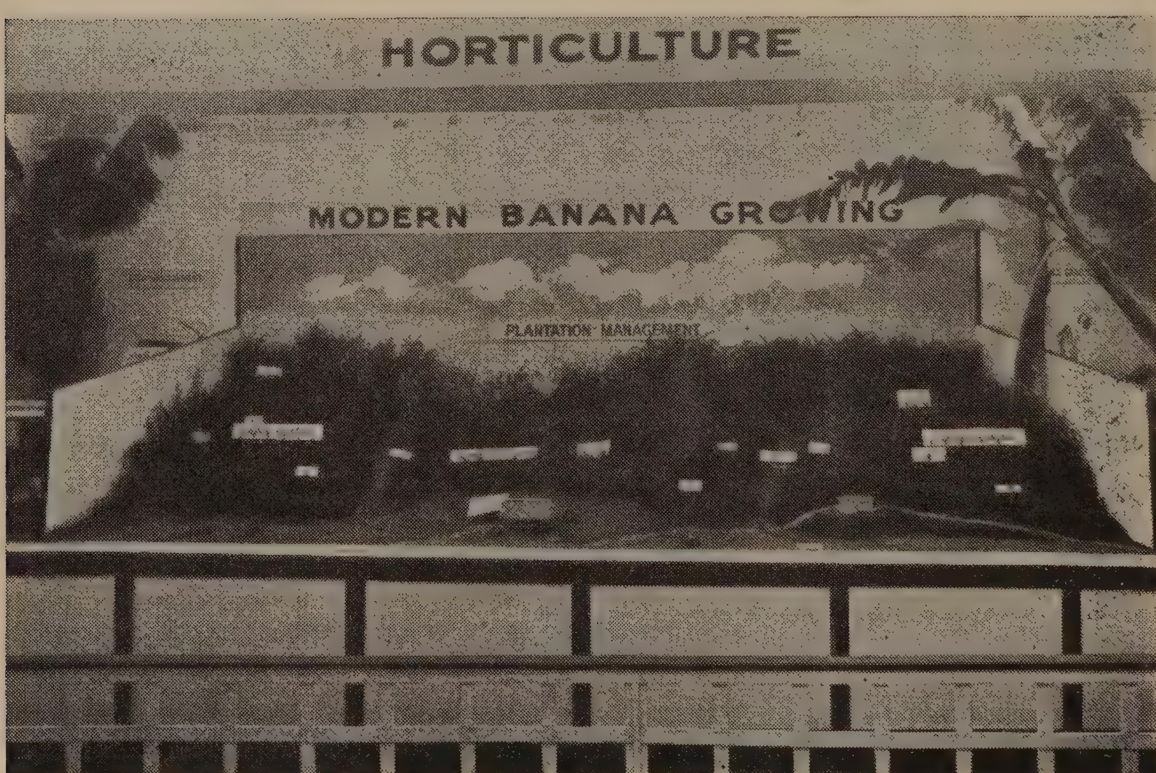


Plate 87.

Broom Millet Press. Top left, side view; bottom left, tray; right, lever.

The Department's Investigational Work With Rice, Tea and Tropical Fibres was Attractively Portrayed by the Agriculture Branch at the Brisbane Show.



Plantation Management was the Theme of the Horticulture Branch's Display at the Brisbane Show. Contour Planting, the Use of Hormones in Eradicating Old Stools, and the Reconditioning of Old Land were Featured.

Horticultural Districts of Queensland.

8. The Dry Tropical Zone.

S. E. STEPHENS, Horticulturist.

UNLIKE most horticultural districts of Queensland, which are compact and closely settled, the North Queensland district extends over several hundreds of miles with many widely separated centres of production. The huge area automatically divides itself into two districts with distinctive rainfalls, and the more southerly of these may be termed the dry tropical zone. This zone extends from Bloomsbury, some distance south of Proserpine, northward along the coast approximately 200 miles to Bambaroo, and westward some 200 miles to Hughenden (Plate 88). The area includes the river systems of the Don, the Burdekin, the Haughton and the Ross, and also several islands off the coast, the most important of which from a horticultural aspect is Magnetic Island.

PRODUCTION CENTRES.

Bowen, with its outlying settlements at Longford Creek, Guthalungra and Gumlu, is the largest and most closely settled centre of horticulture. The Burdekin delta gives first place to sugar cane growing but horticultural crops are grown also by many farmers. Townsville is a newly developing horticultural centre of small crops for local consumption. Magnetic Island is devoted to pineapples and mangoes. In the area known as the Ingham Line, there are a number of small farming groups adjacent to railway sidings along the railway between Townsville and Bambaroo.

Away from the coast the settlement of Woodstock lies at the foot of the coastal range west of Townsville, while over the range farther west are Charters Towers and Pentland, where citrus, grapes and vegetables are grown under irrigation.

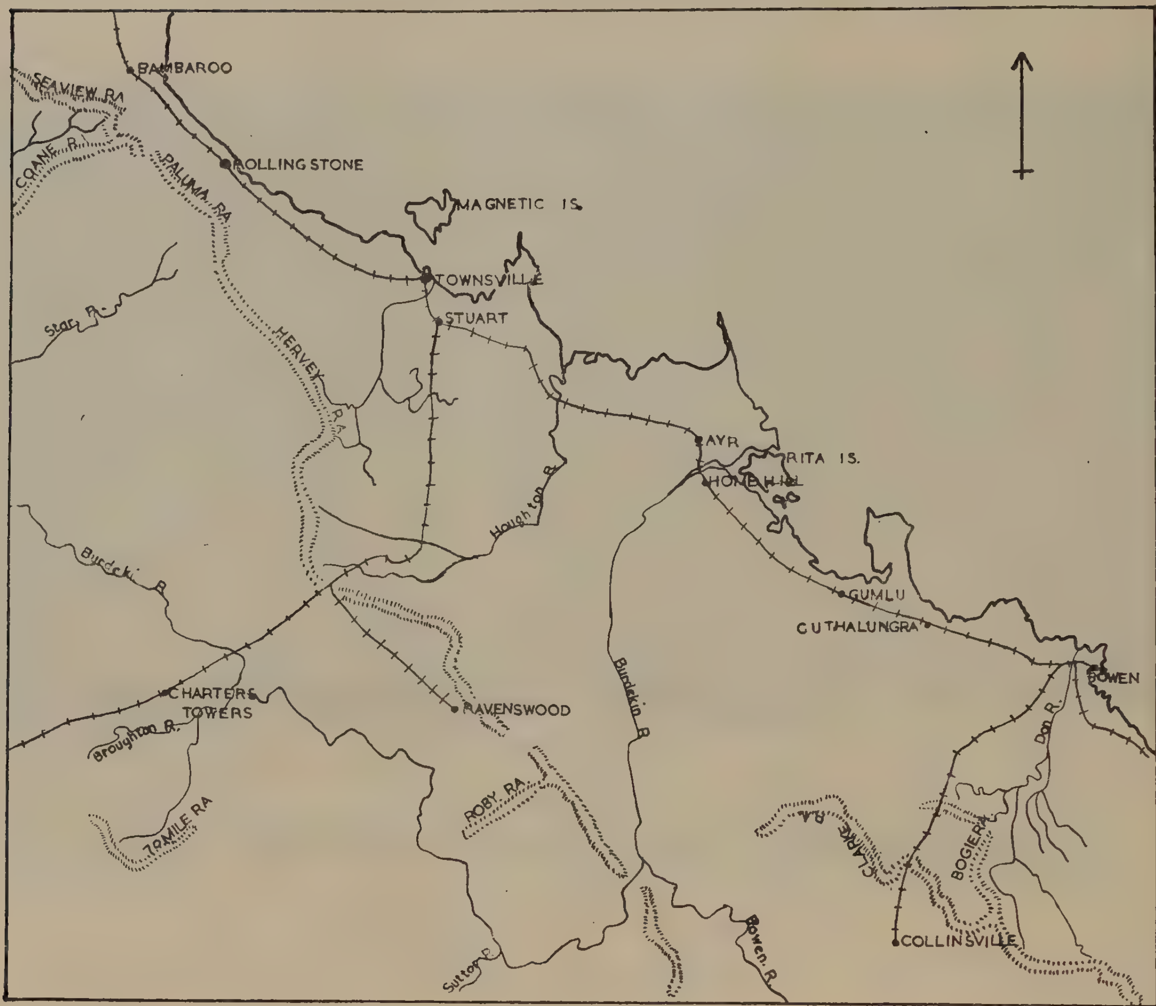


Plate 88.

Sketch Map of the Dry Tropical Zone.

HISTORICAL RECORDS.

Besides being the largest horticultural centre of the district, Bowen holds the distinction of being the first town established in North Queensland. The settlement was founded in 1861 to provide a port for the then newly settled grazing lands of north-western Queensland. After a few years, however, Cleveland Bay was found to offer better facilities and a ready accessible port and Townsville was established on Ross Creek in that bay in 1865. Townsville is now the port for the north-west, and its importance is as a port rather than as a horticultural centre. The population now exceeds 34,000 and the city, therefore, provides a market for the more perishable fruit and vegetable crops that are being produced on a limited scale in the immediate vicinity.

Bowen has developed along rural lines. As the soil near the town was almost uniformly fertile, the land has been subdivided into small areas for close farming settlement and, as climatic conditions permitted the production of crops at periods when shortages existed in other districts, farming development was able to proceed with the assurance of a market for the produce. Even before Bowen was connected with southern markets by rail, a large fruit and vegetable export trade by sea through the port of Bowen to Sydney had been built up. Some years ago, however, rail transport superseded sea transport.

Of the other coastal centres, the Burdekin delta developed from grazing to sugar cane growing and for some years limited quantities of fruit and vegetables have been grown, often as sidelines to cane.

On the Ingham line, horticulture has been a companion industry to sugar cane, as on most farms small cane assignments left the farmers with surplus land upon which other crops could be grown to increase the yearly income. Magnetic Island is chiefly a tourist centre but a fairly extensive pineapple industry was built up from modest early plantings for the local market when it was found that the harvest season corresponded with a season of shortage on southern markets.

The inland centres of Charters Towers and Pentland were developed originally as grazing districts and are still such primarily. Gold was discovered at Charters Towers in 1872, and a few years later on the Cape River at Pentland. For some years gold mining was the major occupation of a population exceeding 30,000. As has been the case in many other rural districts of Queensland, Chinese gardeners saw the opportunities for horticultural production that such a population presented, and demonstrated the horticultural possibilities of the area. With the decline of mining, a number of people turned to horticulture. The establishment of a number of secondary schools and other institutions in the city of Charters Towers maintained a good local market and horticulture has continued to flourish.

TABLE 1.

CLIMATIC DATA FOR DRY TROPICAL ZONE.

—	Jan.	Feb.	Mar.	Apr.	May.	June.
Mean Maximum Temp. (°F.)						
Bowen	87·8	87·5	85·4	82·9	79·7	76·2
Townsville	86·9	87·0	86·2	84·1	80·4	76·6
Charters Towers	92·3	90·6	88·6	85·8	81·1	70·5
Mean Minimum Temp. (°F.)						
Bowen	75·1	74·5	73·1	69·5	63·3	59·3
Townsville	75·8	74·9	73·4	69·6	64·2	60·8
Charters Towers	70·9	70·2	68·2	63·0	57·4	53·1
Average Rainfall (in.)						
Bowen	10·4	8·8	5·8	2·8	1·3	1·6
Townsville	11·4	11·4	7·4	3·5	1·3	1·3
Charters Towers	5·7	4·5	3·9	1·6	0·8	1·3

—	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
Mean Maximum Temp. (°F.)							
Bowen ..	75·2	77·1	80·5	83·7	85·8	87·8	82·6
Townsville ..	75·5	76·8	79·7	82·5	84·5	86·2	82·2
Charters Towers	76·3	79·7	85·0	90·3	90·5	94·4	86·2
Mean Minimum Temp. (°F.)							
Bowen ..	56·5	58·5	63·0	68·4	71·7	73·9	67·2
Townsville ..	58·4	60·4	65·3	70·5	73·5	75·6	68·5
Charters Towers	50·9	53·3	58·1	62·9	67·3	69·2	62·0
Average Rainfall (in.)							
Bowen ..	0·9	0·7	0·8	1·1	1·3	4·4	39·9
Townsville ..	0·6	0·5	0·8	1·4	1·8	5·4	46·9
Charters Towers	0·6	0·6	0·7	0·7	1·4	3·5	25·3

CLIMATE.

Although lying well within the tropical zone, the coastal portion of the district has a climate characterised by moderate summer and mild winter temperatures. Winter frosts are experienced at times but they are not common and are only infrequently of sufficient severity to cause extensive injury to crops. The south-east trade wind, which is the prevailing wind on the coast over the greater part of the year, is at times sufficiently strong to cause some injury to crops planted in exposed situations.

The inland areas are subject to a greater variation between summer and winter temperatures than is the case on the coast. Summer temperatures are frequently high, while the winter minimum temperatures can be expected to reach and sometimes descend below freezing point.

Annual rainfall in all parts of the district is relatively low for the tropics, and as the greater portion falls during the months of January, February and March, irrigation is a necessity for successful horticultural enterprises. The average annual rainfalls for three representative centres in the district are Townsville 47 inches, Bowen 40 inches and Charters Towers 25 inches.

Table 1 shows the mean maximum and minimum monthly temperatures and the average monthly rainfalls for the stations of Townsville, Bowen and Charters Towers.

VEGETATION.

The influence of the long periods of dry weather each year is reflected in the natural vegetation. Open hardwood forest prevails throughout the district. In coastal areas the predominant trees are eucalypts—bloodwood and Moreton Bay ash on the better drained lands, and poplar gum on the more retentive soils. On lowlying areas that tend to become swampy, almost pure stands of paper-bark tea-tree occur.

The Bowen vegetation differs from the general coastal vegetation types, for inland species encroach on the coastal plain. The prevailing eucalypt is grey box, and such western plants as gidyea and prickly acacia are common. Ironbark is common on the ridges.

In the Charters Towers-Pentland area grey box on the flats and ironbark on the ridges is the general rule, but trees of Burdekin plum and of species of *Acacia, Flindersia,* and *Wrightia* are frequent in these stands.

SOILS.

The greater part of the soil under cultivation throughout the area is of alluvial origin; some areas are very old, others more recent, while some are still being built up with fresh deposits left by floods every year or two. The seasonal flooding is a feature of the great Burdekin River, whose extensive watershed extends northward into the high rainfall tropical zone. The Don, the Haughton and the Ross rivers also are subject to flooding in only slightly lesser degree than the Burdekin, but as they are comparatively short the flooding is usually less extensive.

Magnetic Island and some of the soils on the Ingham line are of decomposed granite. These require careful husbandry for the maintenance of their humus content and they are liable to become very hot when exposed to the summer sun. Regular green manuring to increase the organic matter, and cropping to give the greatest shading of the soil, should be routine procedures.

As a general rule, the soils are slightly acid to slightly alkaline in reaction. Most of the areas under crop are suitable for horticultural crops without the addition of lime, except in cases where prolonged cultivation with the use of acid fertilizers and irrigation has increased acidity. Many of the areas devoted to pineapple growing are nearer a neutral reaction than is desirable for this crop.

Zinc and copper deficiencies are prevalent in some crops in inland areas and corrective treatments must be applied at frequent intervals. In coastal areas, the deficiencies are less pronounced but symptoms can usually be observed in the more susceptible plants.

Nitrogen is almost without exception the outstanding deficiency in cultivated lands and the regular use of nitrogen-rich fertilizer mixtures is considered desirable on most crops.

IRRIGATION.

With nine months out of the year dry by horticultural standards, irrigation is an absolute necessity for the production of most crops, and particularly so for vegetable crops that are chiefly grown during the winter and spring months and for such fruit crops as bananas, papaws, citrus and grapes that set and mature crops during the dry months. The delta lands of the coastal area are usually well provided with underground water held in gravel beds at depths ranging from about 15 to 30 feet. The water flow is so free in the Burdekin delta that it is possible to operate centrifugal pumps of up to 12 inch suction diameter from a nest of spears driven into the gravel bed.

Not all water in the delta lands is suitable for irrigation. Several defined areas are known to have saline water underlying them, while certain others are liable to intrusion of brackish water during dry seasons.

At Charters Towers and Pentland, irrigation water is drawn from streams. The cultivated land is invariably an alluvial soil adjacent to creek or river banks. However, the water level is below the dry sandy bed during the period when irrigation is necessary and the texture of the sand is usually such that it is desirable to enclose the intake pipe of the pump in a cylinder of concrete or some other material. As the streams become turbulent during the wet season, it is customary to have the cylinder roofed over and to place it well below the surface of the sand for protection.

HORTICULTURAL CROPS.

Bananas, pineapples, mangoes, papaws, citrus fruits and grapes are the most important fruit crops of the district, and tomatoes, cucumbers, marrows, cabbages and melons the chief vegetable and annual crops.

Bananas.

The banana grows very well on some of the heavier alluvial soils of the Burdekin delta where freedom from frost and protection from winds can be obtained and where irrigation facilities are ample. Fruit quality and size of bunch produced are excellent and plantation life is well above the North Queensland average. The dwarf variety Cavendish is most favoured as it is most easily protected from wind damage.

Pineapples.

Pineapples (Plate 89) are at present produced in greatest quantity and concentration at Magnetic Island, but the Bowen area also has a number of pineapple farms scattered through it. Further expansion on Magnetic Island is limited by the rather small amount of additional suitable land available. The transport difficulties associated with marketing from an island also constitute a considerable handicap to expansion. At Bowen, on the other hand, more suitable land is available although the prevalence of nut grass and danger of frosts limit the choice to some extent. Marketing facilities, however, are good. The Burdekin delta and Ingham line are small producing centres at the present time but both offer good scope for development.

Plate 89.
Smooth-leaf Pineapples at Bowen. This is a plant crop in fruit during October.

Until recent years the Common Rough variety held pride of place in commercial plantations because the fruit was popular on northern markets. The Smooth Leaf variety was grown on a very limited scale to extend the harvesting season, but the sale of the fruit was always considered doubtful. As exports to southern fresh fruit markets increased, however, the area under the Smooth Leaf has increased and recent plantings contain a higher proportion of that variety. The establishment of processing plants in North Queensland is influencing the change to the Smooth Leaf variety and only the shortage of planting material is retarding the transition.

Mangoes.

Mangoes (Plate 90) as orchard plantings are chiefly concentrated in the Bowen area where ''Kensington'' is the favoured variety. This fibreless variety of good colour, flavour and texture was first developed as a commercial variety by the late Mr. H. G. Lott and is now widely

planted for export. Although the variety was developed at Bowen the largest single planting of Kensington mango has been made at Ayr, where an orchard of 1,000 trees exists. Magnetic Island grows mangoes on a smaller scale but possesses several orchards of mixed plantings of fibreless varieties, some of which are of high quality. In the city of Townsville householders and public authorities all grow mango trees, some of a good variety but many of mediocre to poor quality. The crops are bought annually by certain enterprising persons and placed on local and southern markets, but variety, quality and grade are often very mixed in market consignments.

Plate 90.

The Kensington Mango, the Main Commercial Variety in the Dry Zone.

The climate in the greater part of the coastal section of the dry tropical zone is particularly favourable for the mango, as rain rarely occurs during the flowering season and consequently there is seldom much loss or injury from diseases. The harvesting season for the crop usually extends from November to January.

Papaws.

Papaws are grown throughout the coastal section but not on a large scale. The plant can be found in almost every home garden and the local fresh fruit market for commercially grown papaws is therefore very limited. The crop is subject to considerable damage from wind in exposed positions. In the Burdekin area good results are being obtained by growing papaws in the shelter of sugar cane crops.

Yellow crinkle disease destroys some plants every year and at intervals of a number of years causes extensive destruction of plants. However, as the papaw has a relatively short commercial life of only about three years and commences cropping in less than one year, such periodic outbreaks of disease cause only a very temporary decline in papaw production.

Citrus.

Commercial production of citrus fruits is almost entirely restricted to the inland areas of Charters Towers and Pentland, but, as with the papaw, many householders in all parts of the district have one or more trees in their gardens. Oranges grown commercially are chiefly the varieties Washington Navel, Joppa, and Valencia Late (Plate 91),

Plate 91.

Valencia Late Orange, the Chief Variety Grown at Charters Towers.

the range giving a harvesting season extending from April to December. The Valencia Late constitutes almost half of the total orange plantings. Jaffa is grown to a limited extent, more successfully at Pentland than at Charters Towers. Emperor, Ellendale Beauty and King of Siam are the mandarin varieties most generally grown and they are favoured in that order.

Lemons and grapefruit are not grown extensively. The lemon ripens the greater part of its crop during the winter months when the demand for this fruit is at its lowest. Grapefruit are not yet sufficiently appreciated by the public of the north for any extensive market to be available locally.

Close attention to the maintenance of soil moisture is the most important aspect of citrus growing at Charters Towers and Pentland. With high summer temperatures and low relative humidity, transpiration is excessive and failure to maintain a sufficient reserve of moisture in the soil soon leads to the decline and death of the tree. This is well illustrated by the rapid collapse of trees that have been abandoned for a short time.

The customary method of irrigation used is the furrow and basin system in which water is led along a furrow between the tree rows and emptied into basins under each tree. The basins are enclosed by an earth bank about four to six inches high under the outer limits of the tree spread. It is customary to run the water to the farther end of the furrow so that the most distant trees are irrigated first, and then to work back along the row, diverting the water into the basin under each tree. If the land is not reasonably level or has an uneven gradient the water is carried by pipes to positions from which furrows with the required fall can be made. Pipes are also used at times to carry the water across depressions intersecting the furrows.

Fertilizing is necessary to maintain the vigour of trees. Present practices are not standardised but it is customary to use a soil dressing of some kind annually. In the past, some growers have made a regular practice of spreading municipal compost through the orchards and this has done much to maintain the fertility of the soil. The present tendency, however, is to use commercial fertilizer mixtures and some growers supplement these with an additional dressing of sulphate of ammonia in the spring months. In this area, crops of up to five bushels of oranges may be harvested from four-year-old trees, so the necessity for feeding the trees is apparent. The regular use of the trace elements zinc and copper is desirable to maintain tree vigour. Twig dieback and leaf mottling are very conspicuous in orchards where the practice is not adopted.

Fruit fly and larger horned citrus bug are the chief insect pests attacking the fruit. Both cause considerable loss at times. Termites or white ants frequently attack the trees, entering through the roots and working up the trunk and into the branches; boring the trunk and poisoning with an arsenical poison is the control method usually adopted.

Grapes.

The same inland areas of Charters Towers and Pentland are the grape growing districts, and the crop is usually grown in conjunction with citrus fruit on similar soils and with similar cultural methods. The variety Royal Ascot appears particularly suitable to the conditions in the area. It is hardy and of vigorous growth, with good foliage. The fruit has a reasonably tough skin and most of the crop ripens before the end of December, thus escaping much of the storm rains that are liable to cause heavy losses in late maturing grapes. Snows Muscat and Black Muscat Hamburg are grown to a much less extent than Royal Ascot because, although the fruit has a better flavour, the vines are not so robust and the fruit is more susceptible to rain injury.

In trials conducted some years ago at Charters Towers, the variety Servant was found to be suitable for the district. However, it has an amber coloured berry which is less attractive to the general public than the black grapes, flavour and quality notwithstanding.

The common irregularity of winter conditions may cause the vine to break into new growth in early August. It is necessary, therefore, to prune during late July. However, frosts are liable to occur during August so there is always some risk of frost injury during the early spring. The certainty of a market for the crop in northern centres with no risk of competition from other producing districts makes the risk worth taking.

Tomatoes.

The tomato constitutes the greater part of Bowen's horticultural production. Between 1,500 acres and 2,000 acres are planted to this crop annually and fruit in the vicinity of half a million half-bushel cases is marketed, chiefly between the months of May and September. The bulk of this production goes to interstate markets and is harvested and marketed in mature-green condition. A proportion of the crop colours between pickings and, as no local market for this fruit is available, it is discarded in the field as waste.

Tomatoes have been grown extensively at Bowen for many years and Fusarium wilt is a major disease in the area. Wilt resistant varieties of tomato are, therefore, necessary. Farmers have bred their own wilt resistant variety and this is planted to the exclusion of almost all others. The variety (Plates 92 and 93) is known as the Bowen Globe and various local growers have selected strains with the characters considered best for their conditions. The Bowen Globe is a vigorous plant with the main arms reaching 10 to 15 feet, dense laterals and foliage, and well shaded fruit. The fruit is of good size, globe shaped and ripens to a pink rather than the bright red colour of other varieties grown in the State. Yield per plant is heavy and harvesting from the one crop extends over several months.

Plate 92.

Bowen Globe Tomatoes. Note the wide spacing of young plants in the foreground.

As the crop is grown during the dry period of the year, irrigation is essential. Both spray and furrow systems (Plate 94) are used, the choice of method depending mainly on the individual farmer's preference. Intelligently used, both methods give good results.

Winter tomatoes are also produced in the Burdekin delta for interstate markets, the variety grown and the cultural methods adopted being similar to those at Bowen. Charters Towers, Woodstock and some areas north of Townsville cultivate the crop on a much smaller scale for local markets only.

Plate 93.

Bowen Globe Tomatoes at the First Pick. Note the wide ground cover.

Plate 94.

Furrow and Check Bank Irrigation of Small Crops at Bowen.

Melons.

Watermelons are grown for local markets at practically all producing centres. Kleckley Sweet, Klondyke and Cuban Queen are grown fairly generally, and Irish Grey, which is tough skinned and of good carrying quality, is also favoured by Charters Towers farmers.

Rock melons are grown for southern export at Bowen and harvested during the period from October to December. Rocky Ford and Hales Mildew Resistant are popular varieties.

Vegetables.

Most vegetable crops can be grown during the autumn, winter and spring months in coastal areas, but the likelihood of frosts during the winter limits the production of frost-susceptible vegetables at the inland centres.

The more perishable types are grown only in sufficient quantity to supply local requirements, but the cucurbits—cucumbers, marrows and pumpkins—are produced in exportable quantities in coastal areas. They are grown through the late winter months for a spring and early summer harvest, when a satisfactory market is usually available.

PRODUCTION AND MARKETS.

The area under crop and the approximate production during the year 1949-50 are shown in Table 2. As Townsville is the only city of any appreciable size in the district, much of the produce must be exported to other centres. A weekly fruit train running to a fast schedule permits the marketing of the bulk of the Bowen production and a considerable portion of that from the Burdekin Delta on Brisbane and interstate markets.

TABLE 2.

HORTICULTURAL PRODUCTION—DRY TROPICAL ZONE, 1949–50.

FRUIT.

Crop.	Not Bearing.	Bearing.	Production.
Citrus—	Trees.	Trees.	
Navel oranges	400	807	836 bushels
Valencia oranges	3,421	5,022	8,099 bushels
Other oranges	1,834	4,099	5,764 bushels
Mandarins	979	2,490	3,643 bushels
Limes and lemons	421	668	939 bushels
Custard apples	242	390	742 bushels
Mangoes	3,795	10,863	31,327 bushels
	Acres.	Acres.	
Grapes	7	21	60,658 lb.
Bananas	25	62	4,852 1¼ bush. cases
Pineapples	27	206	27,538 1¼ bush. cases
Papaws	6	15	2,539 bushels

VEGETABLES.

Crop.	Area.	Production.
	Acres.	
Potatoes	529	2,595 tons
Sweet potatoes	15	34 tons
Turnips	5	39 tons
Carrots	9	895 tons
Tomatoes	1,602	389,035 ½-bush. cases
Beans (French)	24	1,248 bushels
Peas	7	217 bushels
Cabbages	44	8,528 dozen
Cauliflower	6	796 dozen
Lettuce	2	315 bushels
Melons	82	199 tons
Pumpkins	852	1.156 tons
Marrows and squashes	8	9 tons
Cucumbers	122	7,713 bushels

Local fresh fruit markets are not large and no produce agents operate in any centres except Townsville. In the smaller centres sales are by direct contact between grower and retailer or consumer. A considerable market of this kind exists in the western district of the State and is exploited fairly extensively by growers of the Charters Towers and Pentland areas.

Local markets for processing are available at Townsville and Cairns, and growers desiring to do so can direct certain crops to the Brisbane canneries.

PROSPECTS.

The future of horticulture in the district depends on the markets available. In the past the prosperity of the industry had depended upon the fact that production of some crops has been possible at periods of the year when other districts were unable to grow those crops. However, new varieties, advances in horticultural knowledge, and modifications in horticultural practice are extending the season of production of these other districts so that overlapping is now occurring. The dry tropical zone is at a disadvantage on its distant markets in regard to both marketing costs and lack of freshness of its products after several days' transport to reach the market. The present distant markets for fresh fruit are, therefore, unlikely to offer much scope for future expansion, or indeed to continue as sound as they have been in the past. Future prosperity and expansion would appear to be linked with development of local outlets created by the recent establishment of processing plants in North Queensland. These plants should do much to stabilise horticulture in the district.

JUNIOR FARMERS' ORGANISATION.

Keen disappointment was felt at the cancellation of the Junior Farmers' boys' ''camp,'' which was to have been held at this year's R.N.A. Jubilee Exhibition, and also the A.B.C.'s annual ''leadership'' contest for girls, due to the prevalence of polio throughout the State.

However, arrangements are being made to hold the girls' contest in November next, provided conditions improve to such an extent as to make the holding of the competition possible. The State Director (Mr. T. L. Williams) has been advised to this effect from the Sydney office of the Australian Broadcasting Commission, and also that any of the original 12 contestants selected for the August competition will still be eligible in November, despite the fact that they in some cases may have attained the maximum age limit (21 years) in the meantime.

Girls therefore still eligible for the 1951 ''leadership'' contest, if available, are as follow:—Lenore Saal (Allora club), Gwen. Jones (Clifton), Margaret Davis (Chinchilla), Doreen Rose (Gayndah), Elaine Chapman (Bauple), Edna Zischke (Murgon) or Thelma Kerkow (Wondai), Beverley Robertson (Monto), Joan Hurley (Tully), Mary Pelligrin (Goondi, near Innisfail), Olive Renton (Eton North), Fay Kennedy (Goovigen) and Margaret Maltby (Bowen).

TUBERCULOSIS-FREE CATTLE HERDS.

(AS AT 20th AUGUST, 1951.)

Breed.	Owner's Name and Address of Stud.
Aberdeen Angus ..	The Scottish Australian Company Ltd., Texas Station, Texas F. H. Hutton, " Bingegang," Dingo
A.I.S...	F. B. Sullivan, " Fermanagh," Pittsworth D. Sullivan, " Bantry " Stud, Rossvale, *via* Pittsworth W. Henschell, " Yarranvale," Yarranlea Con. O'Sullivan, " Navillus Stud," Greenmount H. V. Littleton, " Wongalea Stud," Hillview, Crow's Nest J. Phillips and Sons, " Sunny View," Kingaroy Sullivan Bros. " Valera " Stud, Pittsworth Reushle Bros., " Reubydale " Stud, Ravensbourne H. F. Marquardt, " Chelmer," Wondai W. G. Marquardt, " Springlands," Wondai A. C. and C. R. Marquardt, " Cedar Valley," Wondai A. H. Sokoll, " Chelmsford," Wondai
Ayrshire	L. Holmes, " Benbecula," Yarranlea J. N. Scott, " Auchen Eden," Camp Mountain "St. Christopher's and Iona " Studs, Brookfield Road, Brisbane
Friesian	C. H. Naumann, " Yarrabine Stud," Yarraman J. F. Dudley, " Pasadena," Maleny
Jersey	W. E. O. Meier, " Kingsford Stud," Rosevale, *via* Rosewood J. S. McCarthy, " Glen Erin Jersey Stud," Greenmount J. F. Lau, " Rosallen Jersey Stud," Goombungee G. Harley, Hopewell, Childers Toowoomba Mental Hospital, Willowburn Farm Home for Boys, Westbrook F. J. Cox and Sons, " Rosel " Stud, Crawford, Kingaroy Line R. J. Browne, Hill 60, Yangan P. J. L. Bygrave, " The Craigan Farm," Aspley A. Verrall and Sons, " Coleburn Stud," Walloon R. J. Crawford, " Inverlaw Jersey Stud," Inverlaw, Kingaroy P. H. F. Gregory, " Carlton," Rosevale, *via* Rosewood E. A. Matthews, " Yarradale," Yarraman A. L. Semgreen, " Tecoma," Coolabunia G. & V. Beattie, " Beauvern," Antigua, Maryborough L. E. Meier, " Ardath " Stud, Boonah
Guernsey	C. D. Holmes, " Springview," Yarraman

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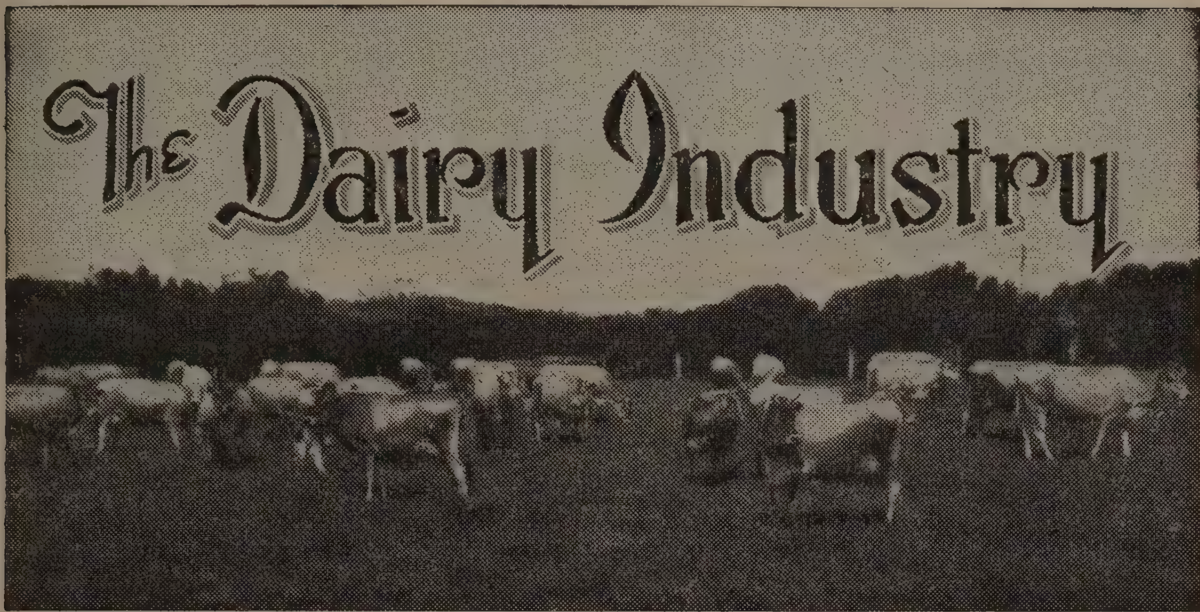


The Care and Operation of Milking Machines.

J. D. ELRINGTON and E. B. RICE, Division of Dairying.

THERE are estimated to be 13,000 milking machines in use on dairy farms in Queensland, and this number is being constantly increased as the scarcity of farm labour and other economic factors force farmers to depart from the hand milking of dairy cows.

It is clear from investigations and the practical experience of many farmers that the yield of milk and butterfat, the persistency of lactation and the health of the dairy cow are not detrimentally affected by machine milking, provided the machine is maintained in efficient condition and good machine milking practices are adopted.

High quality milk can also be produced consistently by machine milking if recommended cleaning and milking procedures are followed.

Milking machines may be broadly grouped into *releaser*, *bucket* and *independent unit* types. All that is needed for efficient machine milking is a simple machine with stable vacuum and regular pulsation, and correct training of the cows. The special "gadgets" fitted to many machines are quite unnecessary. It is, of course, necessary to supply some form of motive power for the milking machine, and this usually takes the form of an internal combustion engine or electric motor. A power unit of 1-1½ h.p. usually suffices for the machine alone, but as it is general practice to separate while milking, a 3 h.p. engine is recommended. This gives sufficient reserve power to operate additional equipment, such as lighting plant and skim milk pump.

RELEASER-TYPE MACHINES.

A releaser milking machine consists of the following parts:—

1. Vacuum pump.
2. Vacuum tank.
3. Vacuum gauge.
4. Relief valve.
5. Pulsators.
6. Teat-cup assembly.
7. Releaser.
8. Sundry metal and rubber tubes, sight bowls, &c.

Vacuum Pump.

By drawing air out of the pipes, the vacuum pump creates the partial vacuum essential to the operation of a milking machine. It has been found that the "effective displacement" of the vacuum pump has a most important bearing on the efficiency of milking. In practical operation "effective air flow" is governed by the size and efficiency of the pump, the amount of leakage in joints, pulsators, &c., and the sensitivity of the relief valve.

A piston pump was formerly used on milking machines, but it has now been displaced by the rotary vacuum pump. There are various designs of pump but the principle of operation does not differ.

Plate 95 shows an interior view of a common type. It consists of an external cylinder or case enclosing a rotor which is set "off centre." The rotor contains two blades separated by two pins and two coil springs. The rotor assembly is supported in ball bearings.

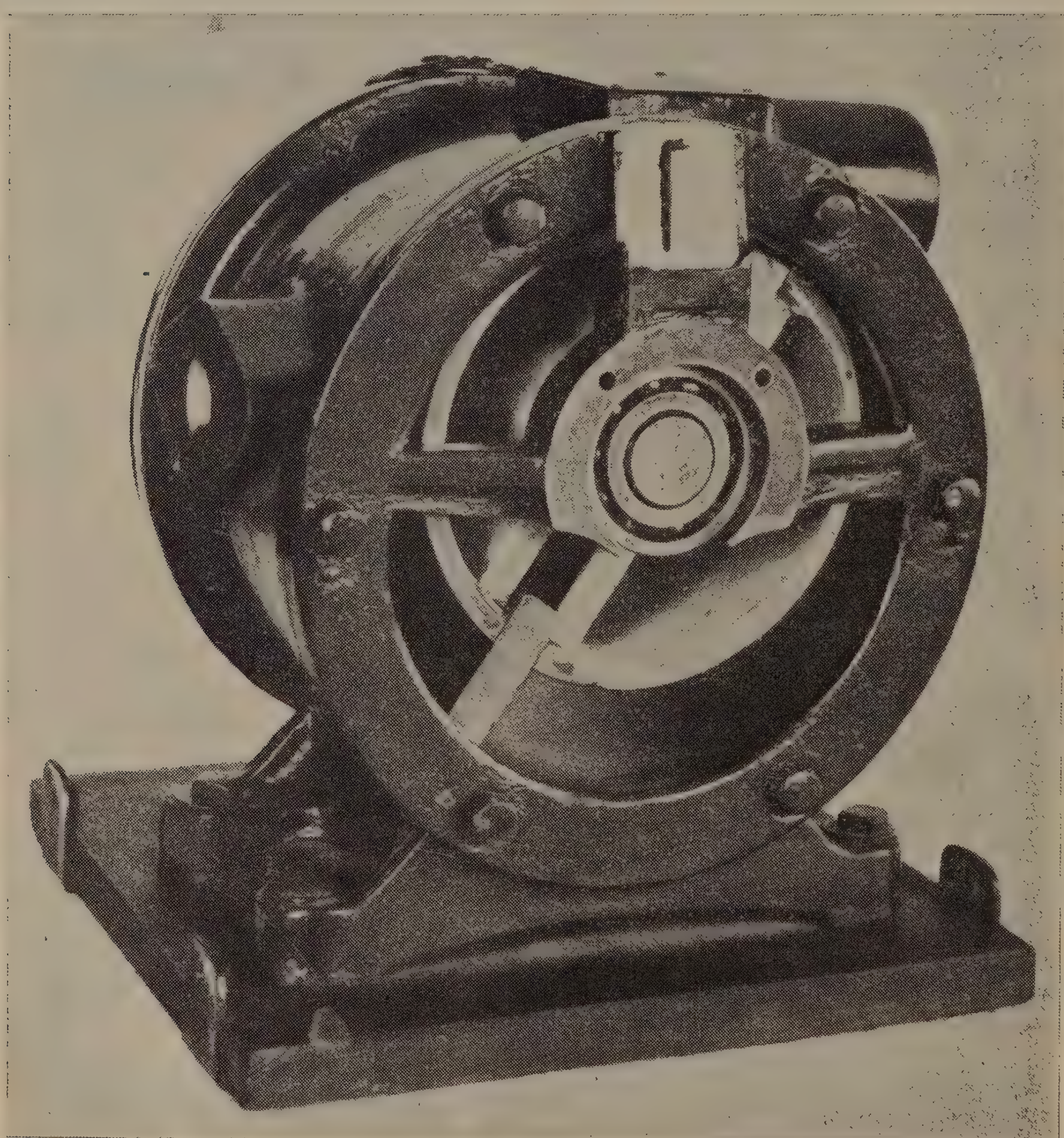


Plate 95.

Rotary Vacuum Pump Used on Milking Machines.

Given proper care the pump will last indefinitely. However, as it is finely machined, neglect will not only cause excessive wear and loss of efficiency, but ultimately will necessitate its reconditioning or replacement.

The vacuum pump depends on oil to provide an airtight seal. Only the special vacuum pump oil should be used to lubricate it. The two oil wells, one on each side of the pump, should be refilled before each milking, as, if the lubricating system is efficient, the oil wells should not be more than half full after each milking.

The oil wick should be removed and cleaned weekly or replaced. At the same time a piece of fine copper wire should be slid down the oil tube to make sure the oil can flow freely down to the bearings. A three inch length of good quality pipe cleaner will make an ideal oil wick. Bending it in the form of a U with legs of equal length will ensure that sufficient oil reaches the bearings. Oil wells should be cleaned thoroughly every three or four weeks.

During cold weather a knocking sound may be heard when starting the pump, but it should cease after one or two minutes running. It results from the oil being too thick or gummy, which causes the blades to stick in their slides. This knocking is not harmful and there is no need to dismantle the pump. To avoid this trouble during cold weather, a few drops of petrol may be poured down the oil feed pipe after removing the wick. If this is done it is important to replace the oil wick before commencing the next milking. It is also advisable in cold weather to operate the pump without vacuum load for about one minute to allow the oil to become fluid. If a clatter persists the pump has a serious fault necessitating expert attention.

If a moisture trap is fitted to the vacuum pump, it should be cleaned before every milking to prevent the entry of dust and moisture into the pump.

Vacuum pumps are made in various sizes, and the firm supplying the machine will fit a pump of sufficient capacity for the number of sets of cups on the machine. The pumps are operated at speeds between 250 and 400 revolutions per minute, depending on the number of units (sets of teat cups) on the machine. The correct speed is that which gives an adequate flow of air through the relief valve when all teat cups are on the cows and the machine is operating at a normal vacuum. If an extra bail is added to the shed, or the machine " doubled up," the pump speed will also need increasing.

The best drive for a vacuum pump is given by a V-belt, but as its use is not always practicable, a flat belt is often used. The belt drive must be kept in good condition, free from oil, just snug when stationary, and with a slight sag on the loose side when running. A tight belt overloads the bearings unnecessarily and moreover is not always one which will not slip. A slipping belt should always be promptly attended to.

Vacuum Tank.

The maintenance of a steady vacuum level is important for efficient machine milking. The relief valve, or vacuum regulator, can, to some extent, control the vacuum, but the function of the vacuum tank is to assist in preventing sudden changes; it is, in effect, a vacuum reservoir. For example, it smooths out the immediate effect of the sudden inrush of air when a set of teat cups falls off a cow, or the cups are being changed from one cow to another. It also acts as a trap to prevent milk froth and condensed moisture passing from the pipes of the machine to the vacuum pump. The only trouble likely with this part of the machine is leakage of air due to perished rubber rings, which should be tested for with a lighted match.

Some machines have no vacuum tank, but in order to serve a similar purpose, the inner chamber of the releaser is usually larger than in a machine fitted with a vacuum tank.

It should be noted at this stage that good design of milking machines involves correct placement of the various parts relative to one another. The vacuum regulator valve and vacuum gauge are preferably mounted as close as practicable to the vacuum tank, where the fluctuations in the vacuum are less than elsewhere on the machine. Therefore, the control and measuring of the vacuum are more efficient in this position.

Vacuum Gauge.

The only reliable vacuum measuring device is the mercury column or manometer. However, as it is too fragile and cumbersome for use in the milking shed, the Bourdon type vacuum gauge is in universal use on milking machines. The front of this gauge, with the graduations 0—30 and the pointer, is familiar to every dairy farmer, but Plate 96 shows the gauge with the back removed. It consists of an elliptical tube, sealed at one end and open at the other, connected *via* a suitable link system to the pointer. When the open end of the tube is connected to the milking machine and the vacuum pump started, the reduced pressure inside the tube allows the atmospheric pressure to bend the tube, thereby pushing the needle around on the face of the instrument.

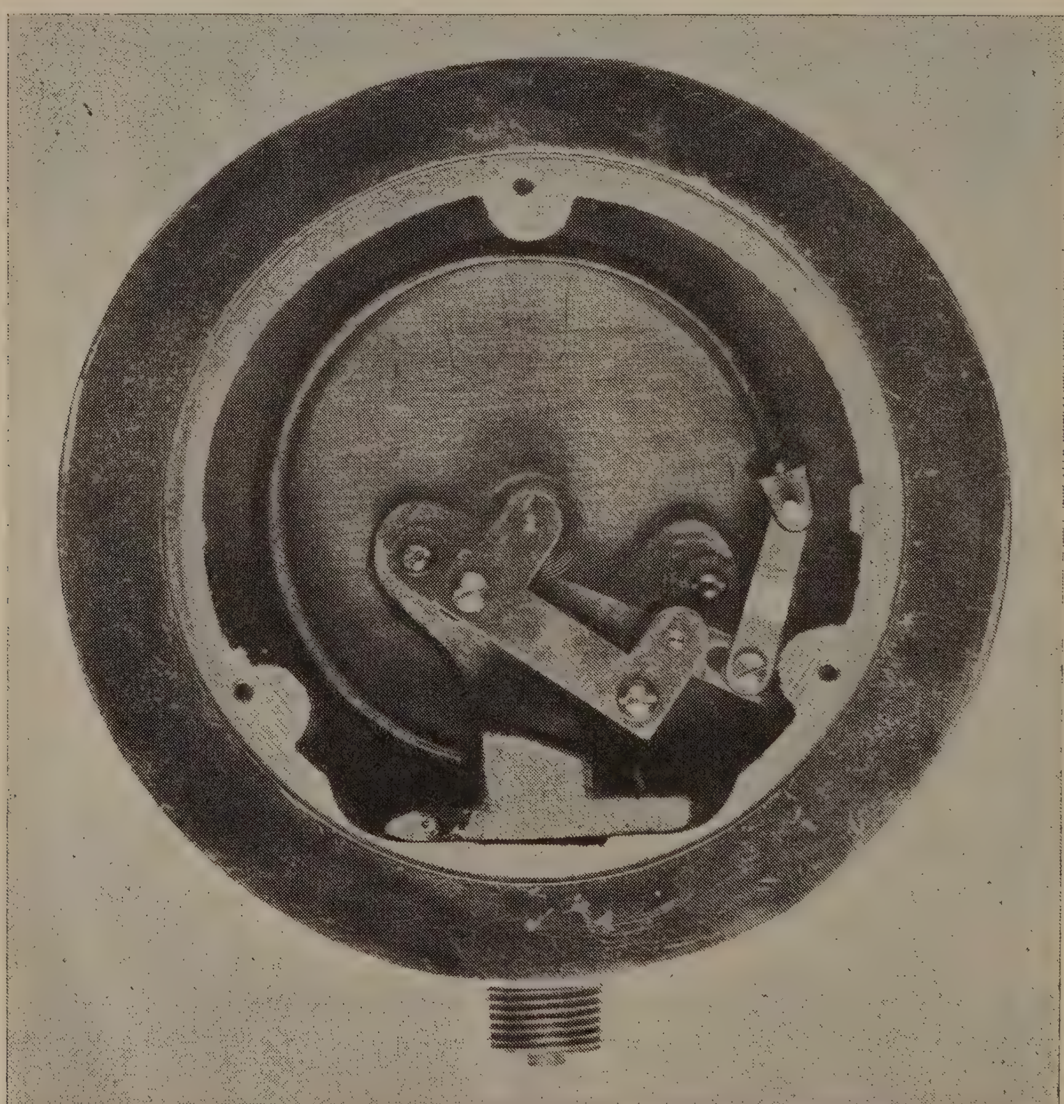


Plate 96.

Interior of Vacuum Gauge.

In spite of several weaknesses for cowshed use, this gauge is the only practical one for the purpose. The slamming of the pointer against the zero stop as the vacuum is released, changing vacuum which wears the working parts, and dirt and moisture finding their way into the mechanism, all affect the accuracy of the gauge. A high proportion of gauges tested on farms has been found to give inaccurate readings. Often the true vacuum is several inches higher or lower than that recorded by the gauge pointer.

If a farmer is troubled with the teat cups falling off cows and the gauge reads 13-15 inches, the normal range for machine milking, the gauge should be suspected; probably the true vacuum is several inches lower. Within a range of several inches above or below 14, vacuum level does not appreciably alter the rate of milk flow from the cow. However, as high vacuum can cause discomfort to the cow and actually damage the delicate udder tissue, milking should not be done at a vacuum over 15 inches.

From what has been said, it can be understood that, under farm conditions, the actual reading of the pointer on the vacuum gauge is often not entirely trustworthy. It is therefore recommended that the gauge should, at least once yearly, be overhauled, cleaned and checked against a true gauge or a known source of vacuum. Field officers of the Division of Dairying of the Department of Agriculture and Stock are supplied with a tested vacuum gauge, which is frequently re-checked, and the local officer will be glad to check the gauge on the milking machine for any dairy farmer in his district. If the gauge should prove to be in poor working order, sticking or not showing a true vacuum reading, it should be sent to the distributor for repairs or replacement.

Relief Valve or Vacuum Regulator.

Successful machine milking is dependent largely on the ability of the vacuum pump to maintain the desired vacuum in the machine. Some air is necessarily admitted to the machine by the pulsators to enable the inflations and releaser to perform their special functions during milking and through the small hole in each claw to enable the milk to be carried away to the releaser.

As indicated earlier, a good vacuum pump should have sufficient capacity to remove all of this air and sufficient reserve to cope with a few leaks and any sudden inrush of air; for example, when the teat cups fall off or are changed from cow to cow.

The object of the relief valve is to control the vacuum in the milking machine. If the vacuum rises above the desired limit, it must admit air, and conversely, shut it off if the vacuum falls too low.

Relief valves or vacuum regulators are of three types, shown in Plate 97, namely:—a, spring-loaded ball valve; b, spring-loaded poppet valve; c, weighted valve.

In exhaustive tests on relief valves in New Zealand, all ball valves were unsatisfactory for controlling the vacuum on milking machines. A few spring-loaded poppet valves nearly reached the desired standard, but most were well below. Weighted valves gave much better results. Another advantage of the weighted valve is that, being operated by a fixed weight, so long as it is kept clean and in good condition, the

vacuum is kept at the required level and cannot become too high. Thus, if the vacuum gauge is registering incorrectly, the farmer is not misled; in fact, the vacuum gauge could be dispensed with on machines fitted with a weighted relief valve.

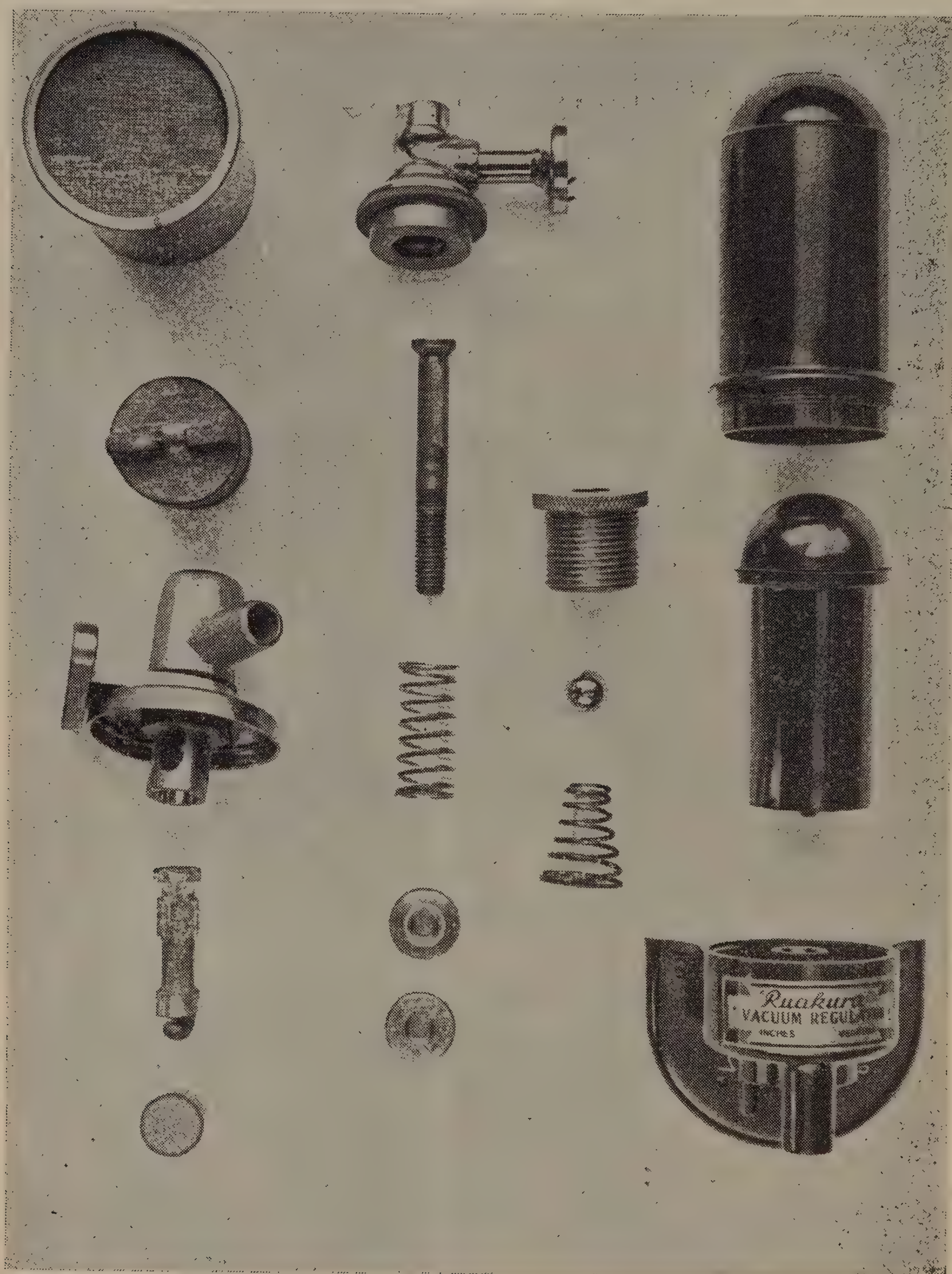


Plate 97.

Types of Relief Valves or Vacuum Regulators. Left to right—weighted type; mushroom type; ball type; weighted type.

There should be a flow of air through all relief valves most of the time during milking. This air carries dust, which quickly fouls the valve. Consequently, the valve should be dismantled and cleaned weekly and a drop of oil put on the stem of poppet types. If the

valve seat shows signs of wear or corrosion, it may be ground in, using some metal polish or rouge. Valve grinding paste should not be used. The ball in the ball type valves becomes pitted with rust after some time, and should be replaced.

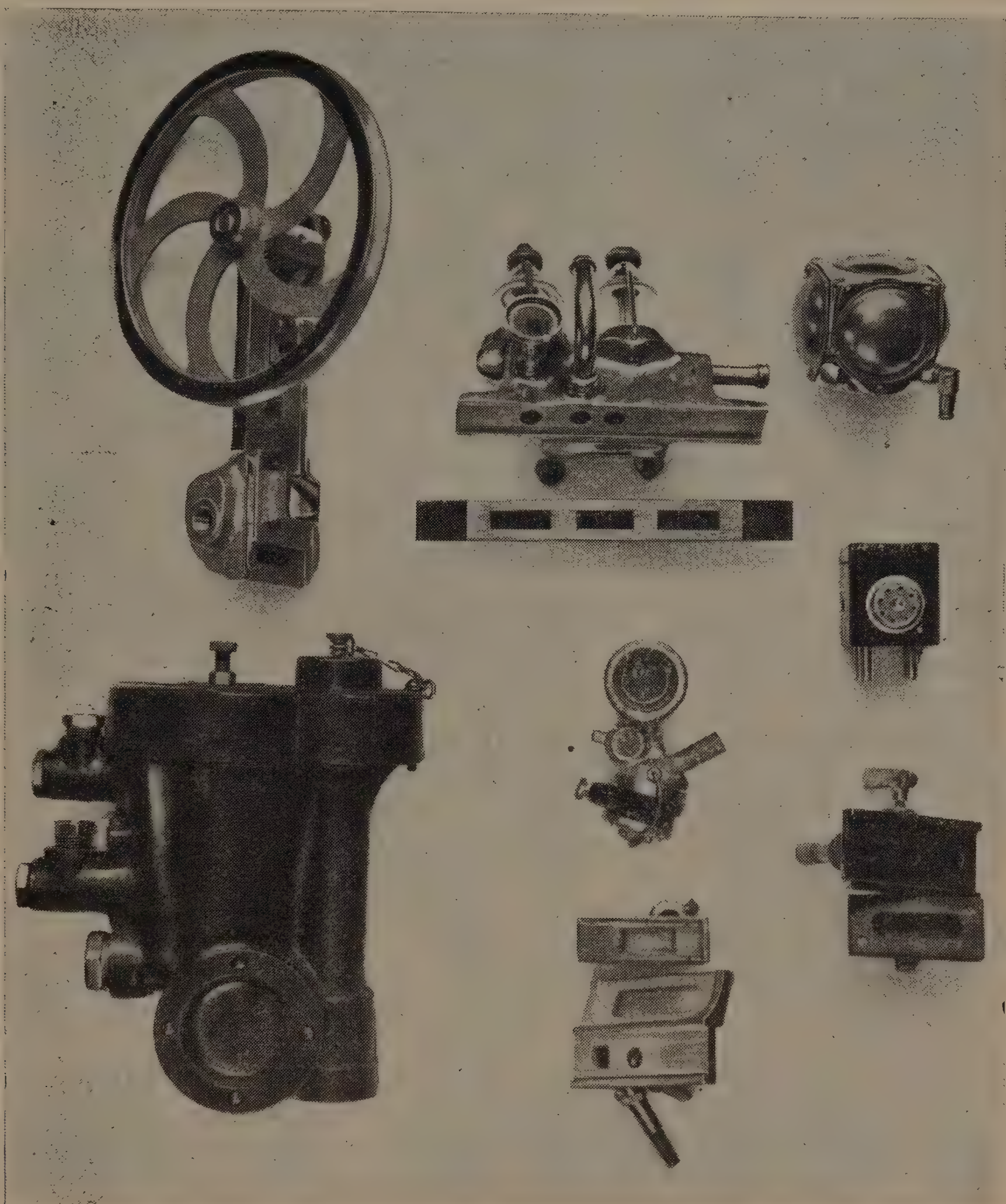


Plate 98.

Pulsators in Use on Milking Machines. Starting at left hand side and reading downwards:—Ridd (slide); Waugh and Josephson (rotary); McDonald Imperial (slide—single pipeline machine); Alfa (magnetic); Alfa (slide); International (automatic—single pipeline machine); Alfa (automatic); Simplex (slide).

Pulsators.

The pulsator is the device which, by producing an intermittent vacuum, causes the squeeze and release of the inflation in the teat cup during milking. The milking machine sucks the milk from the udder of the cow and the pulsator causes the inflations to have a massaging effect on the teats, so maintaining circulation and avoiding swelling. The pulsator is also used to operate the releaser.

Every milking machine is fitted with one or more pulsators, of which there are numerous designs (see Plate 98). The types can be classified as follows:—

(*a*) Slide.
(*b*) Rotary.
(*c*) Automatic.
(*d*) Magnetic.

The pulsators require some attention to ensure their efficient operation. This involves lubrication and correct adjustment.

Lubrication.

Slide Type.—Clean thoroughly every week and apply a smear of odourless petroleum jelly to the bearing surfaces. If the pulsator slide is fitted with felt oil wicks, apply a few drops of light machine oil to the wicks weekly. The non-oiling type will be improved by the application of a little odourless petroleum jelly. It is seldom realised that when a pulsator is working there is considerable pressure on it because of the different pressures on each side of the slide. Therefore adequate lubrication is essential. However, if excess oil is used the vacuum will draw this oil into the air lines, which may cause contamination of the dairy produce.

Rotary Type.—These pulsators are usually located on the vacuum pump and are lubricated with either grease or oil. The recommendations in the instruction book supplied with the machine should be followed.

Automatic and Magnetic types as a general rule require no lubrication. However, the recommendations in the instruction manual should again be followed.

All pulsators should be wiped over with a greasy rag once weekly to clean off dust.

Adjustment.

When adjusting pulsators there are two factors to consider—firstly, the number of pulsations per minute, and secondly, the ratio of squeeze to release of the inflation for each stroke of the pulsator.

Usually the rate of pulsation, as fixed by the manufacturer, will not alter as long as the farmer attends to the drive, especially in belt-driven types, to insure that there is no belt slip. It normally lies between 42 and 48 per minute. Experience has shown that this is a satisfactory rate, although one make of machine milks quite satisfactorily with a pulsation rate of 65 per minute. The main requirement is that the pulsations should be regular and even.

The ratio of squeeze to release usually lies between 25-75 and 50-50, the most common being 50-50. Incomplete experiments reported in New Zealand suggest that a longer squeeze than 50-50 with some cows causes a decline in the rate of milk flow. In other words, the machine then becomes the limiting factor in milking. For this reason, in order to operate well away from the limit at which milking commences to slow up, a 25-75 ratio has been suggested as a convenient working figure. There are no known disadvantages in using a short squeeze action. However, where doubled-up units are used (that is, two sets of cups to each bail and pulsator) the ratio must be set at 50-50. The ratio for the releaser pulsator must also be set at 50-50.

Within the range mentioned, the ratio of squeeze to release is not critical, the important factor being to ensure that it is the same in every bail, because not always are the same cows milked in the same bails.

Should the pulsators get out of adjustment, the best plan is to start the machines and adjust each pulsator in turn so that each set of cups has the same length of time for squeeze and release. Instruction books issued for each make of machine should show how to adjust the pulsators. All brackets, driving collars, connecting rods, &c., should be checked monthly for slackness.

Teat-cup Assembly.

Plate 99 shows two of many commonly used types of teat-cup assembly or claws. As most farmers know, there is a small hole in the end of the claw on all releaser type machines. Claws of bucket plants and machines with a plunger pump in every bail do not have this hole. The hole is placed in the claw to admit air, which assists in raising the milk to the overhead milk line, and so prevents the teat cups from flooding and falling off. Most farmers also know from experience that if this hole becomes blocked with a fly or a speck of dirt, the cups will fall off the cows. However, cases of cups falling off a few cows in the herd, usually the easy milkers, are often due to the hole being partly clogged with dirt. Each time the claw is washed, a needle or piece of fine wire should be pushed through this hole to ensure that it is quite clear. Blocked air admission holes may be associated with a higher incidence of mastitis.

Inflations should be cleaned thoroughly after each milking by following the recommendations for the cleaning of milking machines summarised at the end of this article. This will aid in producing clean milk and in preventing udder troubles. If boiled once weekly in a weak caustic soda solution (5 per cent.) their "life" will be lengthened. The inflations should be kept taut, but not over-stretched, and replaced as necessary. Field observations have shown no special advantages for either plain or moulded inflations. It may also be mentioned that for success in omitting hand stripping after machine milking, the teat cups, which tend to crawl up the teat and prevent the complete withdrawal of milk from the udder, should be gently pulled down towards the end of milking. Discomfort and even damage to the udder may result if cups are left too long on cows after the milk flow has ceased.

Releaser.

The releaser enables the milk to be removed from the milking machine without breaking the vacuum and allowing the teat cups to fall off. Plate 100 will assist to explain the principle of its operation. It consists of two chambers A and B, and two flaps D and E, operated by a pulsator which connects the outer chamber B, to the vacuum pump, and pressures between the inner and outer chambers are equalised. The weight of milk then opens the inner flap D and the milk flows through to the outer chamber B. Meanwhile the atmospheric pressure keps the outer flap E closed tight. On the next stroke of the pulsator, the atmospheric air is admitted to the outer chamber B, sealing the inner flap D and equalising the pressure on both sides of the outer flap E. The milk can then force this flap open and flow out.

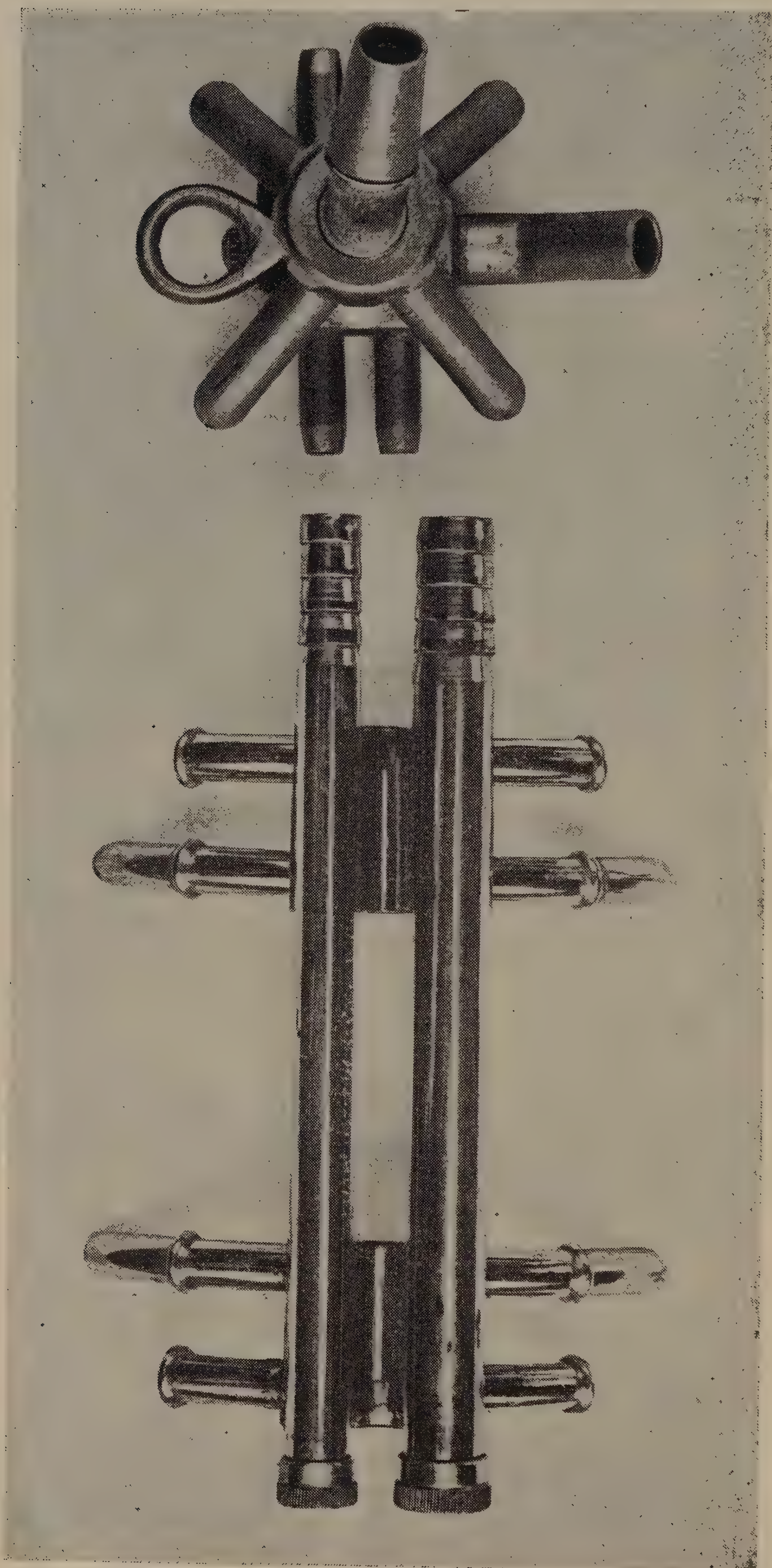


Plate 99.

Claws for Teat-cup Assembly. Top, Ridd; bottom, Alfa Daisy.

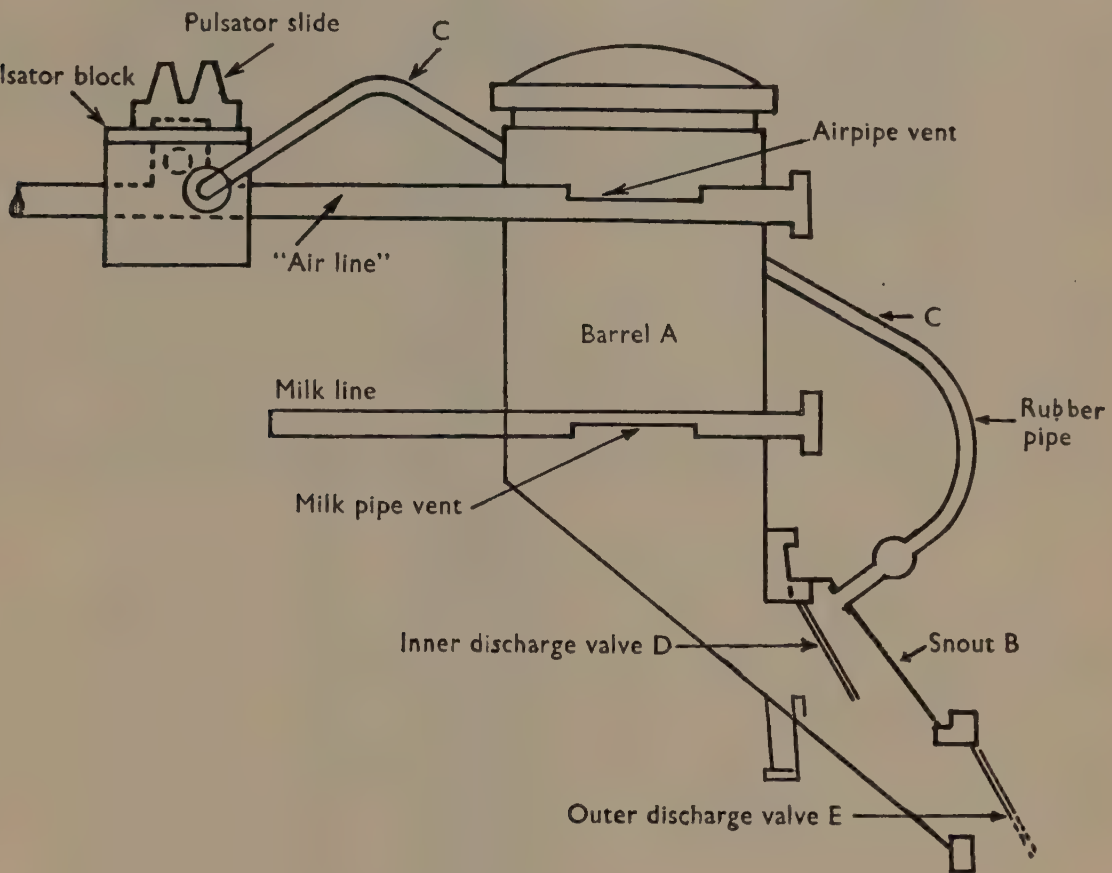


Plate 100.

Details of the Operation of the Releaser.

(From " Dairy Farming in Australia.")

The usual faults which occur with a releaser are caused by air leaks. These leaks make it impossible to equalise pressures, and the milk cannot be released. This milk eventually finds its way into the air section of the machine and flows along to the vacuum tank and pump. The remedy is obviously to find the leaks and seal them. The usual places are the flaps. which if cracked and worn, should be replaced. Other trouble spots are (*a*) the rubber seal between the two chambers; (*b*) the rubber tube from pulsator to outer chamber, including its connection to pulsator and releaser; and (*c*) the pulsator itself.

These parts can be examined with a lighted match to locate any air leaks. A similar examination should be made periodically for air leaks at joints, bungs, rings, &c., on other parts of the milking machine.

Sight Glass.

A sight glass on the milk pipeline helps to ensure that teat cups are removed as soon as the cow is milked out. Cups left on too long may damage the udder and predispose to mastitis.

BUCKET TYPE MACHINES.

In this type of machine the milk is drawn from the cow in the usual manner, using teat cups and claw of conventional design. The milk is delivered into a vacuum bucket which is usually stood beside the cow, but in some overseas models is suspended from the cow with a surcingle. Therefore the milk line and releaser are not used with bucket machines.

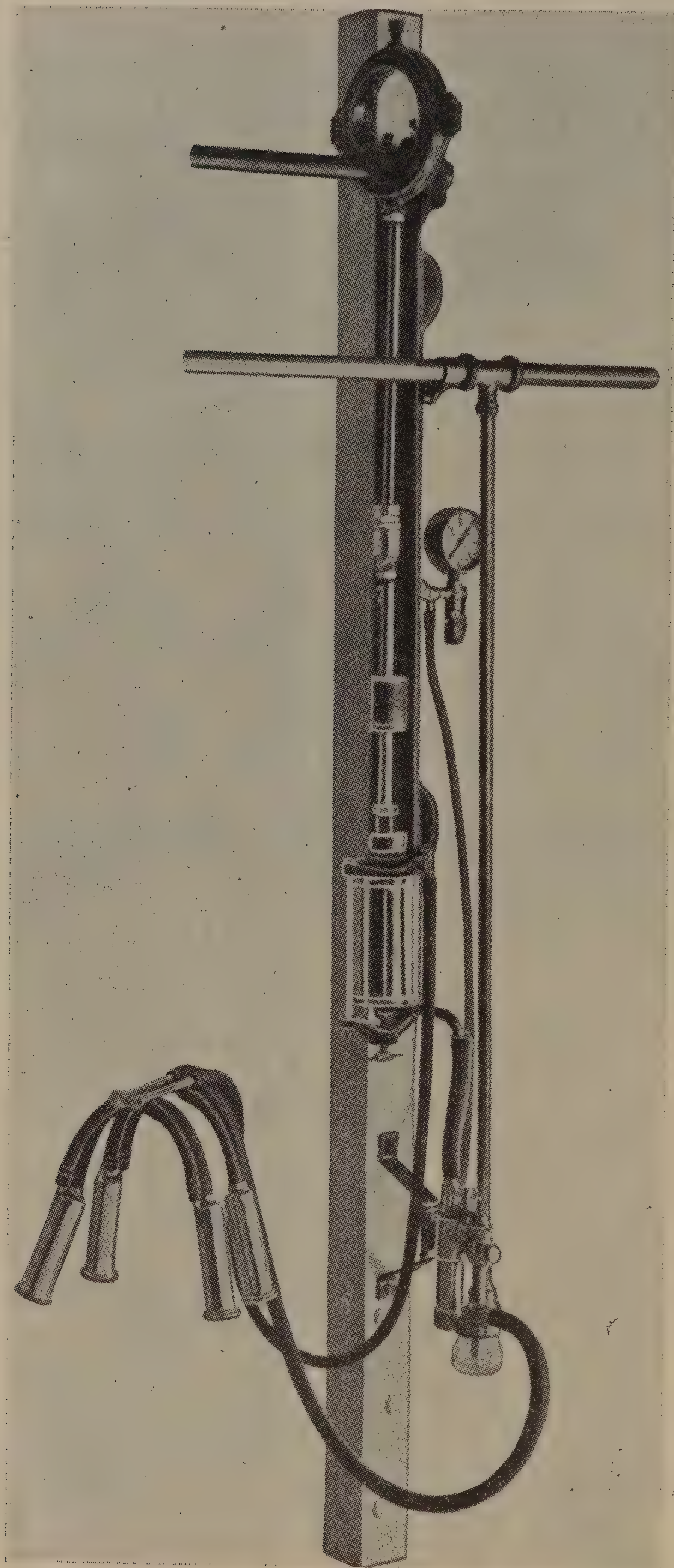


Plate 101.

An Independent Unit Machine.

Pulsation is arranged by the use of an automatic pulsator attached to the bucket, and the complete unit—that is, claw, bucket, and pulsator—is portable and ideal for use where stall feeding is practised. The machine consists of vacuum pump, vacuum tank, vacuum gauge and relief valve, as in releaser machines, and a vacuum line is erected so that there is a tap near each cow to supply vacuum to the bucket, pulsator, and cups.

Bucket plants are not used to any appreciable extent in Queensland. Since dairy herds are grazed in open paddocks and separate feeding stalls are recommended rather than feeding while milking, the moving of the bucket from cow to cow and carrying of the milk from the cow to the separator room make this type of plant slower and less convenient to operate than the releaser-type machine.

INDEPENDENT UNIT MACHINES.

One make of milking machine sold in Queensland has a pump in every bail. The complete unit is shown in Plate 101. The operating cycle of this type of plant is discussed for the information of owners.

Each stall unit is complete and independent of the other units. In addition to the orthodox teat cup assembly, it is fitted with a double-acting pump, a vacuum regulator valve, a vacuum gauge, a relief valve and a milk chamber containing three valves, sight bowl, and connection to the milk line.

The double-acting pump supplies the energy for milking the cow, creating the pulsations, and pumping the milk to the overhead milk line for conveyance to the milk vat by gravity.

On each revolution of the drive shaft the pump makes two strokes.

The following describes the action of the top section of the pump. The down-stroke of the piston opens the inflation by raising the vacuum above the pump and therefore through the pulsation line to the outside of the inflation. During this phase, milk flows from the teats.

The up-stroke of the piston reduces the vacuum in the pulsation line to atmospheric level. The difference in pressure on each side of the inflation—that is, vacuum on the milk side and atmospheric pressure on the pulsation side—causes the inflation to close against the teat, and so provides the necessary "rest" and "massage" of the teat.

At the top of the tube leading from the top-section of the pump there is a ball valve, to allow any excess air to escape on the upward stroke and ensure that only atmospheric pressure is applied to the teat during the closed phase of the inflation. This valve is called the relief valve, and hissing from this valve during operation of the unit indicates an air leak, which may occur in any of the following places:—

(1) in the pump from bottom to top section;

(2) around the gland at the top of the pump;

(3) through the seal at the top of the pump barrel;

(4) around the mouth or nut of the teat cups;

(5) through the cap or rubber connections to the claw;

(6) through a split inflation.

Milk spray through this valve would immediately suggest a split inflation in that particular set of cups. For maximum efficiency all of these leaks should be sealed, when hissing from the relief valve will cease.

The bottom section of the pump operates as follows:—The down-stroke closes the inlet valve in the milk chamber and so prevents vacuum being entirely lost between the inlet valve and cups during the open phase of the inflation, at which time milk is flowing from the udder. This stroke also opens the delivery valve and pumps milk from the milk chamber to the overhead milk line. The up-stroke closes the delivery valve, preventing return of the milk, opens the inlet valve, allowing milk to flow into the milk chamber, and raises the vacuum in the milk section to draw milk from the cow and hold the cups on. The third valve in the milk chamber is a simple ball-valve to check any milk entering the pump.

The regulator valve situated under the vacuum gauge controls this vacuum and the vacuum gauge measures the vacuum.

It is essential that there be no air-leaks in this section of the machine, and that the valves seat perfectly. Every joint is provided with a fibre washer, and this washer must be replaced after normal cleansing operations. It should be noted that there is *no* hole in the claw of this machine.

The company distributing the machine publishes an instruction book, in the back of which is an efficiency test. If this test is applied to each unit and the necessary adjustments made, a job taking only a few minutes each week, no difficulty will be experienced in operating. These books are available to farmer operators of this machine.

SUMMARY.

The mechanical aspects of milking machines which are of chief importance for efficient milking are:—

(1) The vacuum pump should have an adequate air displacement.

(2) The relief valve should be reliable and sensitive.

(3) Pipe joints, rings, flaps, &c., must seat properly to prevent air leaks.

(4) The slides of the pulsator must fit properly to stop air leaks and the pulsator action must be regular.

In the milking process the main points are:—

(1) Avoid noise and rough handling of cows. Secure the co-operation of the cow by kind treatment at all times.

(2) Check the foremilk and wash the udder to stimulate milk let-down about one minute before milking begins.

(3) Avoid a high vacuum; adjust the relief valve to "blow off" at 14 to 15 inches vacuum.

(4) Remove the teat cups as soon as milk flow ceases.

(5) Maintain inflations taut and in good condition and replace as necessary.

(6) Strip by machine. If necessary, bear down on the claws to remove the last milk.

In cleaning the machine the procedure to follow is:—

(1) Just before each milking flush the milk system with clean, cold water containing a chlorine compound in the proportion indicated by the manufacturer.

(2) After use, rinse each unit with at least 1 gallon of cold water.

(3) Run through the milk system a hot, dilute caustic soda solution (1 level dessertspoonful of caustic soda to 4 gallons of hot water), using 1 gallon of the solution to each set of teat cups.

(4) Run plain *boiling* water through each set of teat cups, using at least 1 gallon (preferably 2) of boiling water for each unit.

(5) Sterilize the milk system with steam.

(6) Once daily thoroughly cleanse the air lines.

(7) Remove and dismantle the releaser and vacuum tank, wash each thoroughly, sterilize with steam and store in a dust-free place.

(8) Disconnect teat cups and all rubbers. Open up all flaps or remove rubber plugs on the machine.

(9) At least once a week completely dismantle the machine and thoroughly cleanse and sterilize it.

Proper training of the cows, together with regular and systematic cleaning, lubrication and adjustment of the various working parts of the milking machine, will ensure efficient, trouble-free milking.

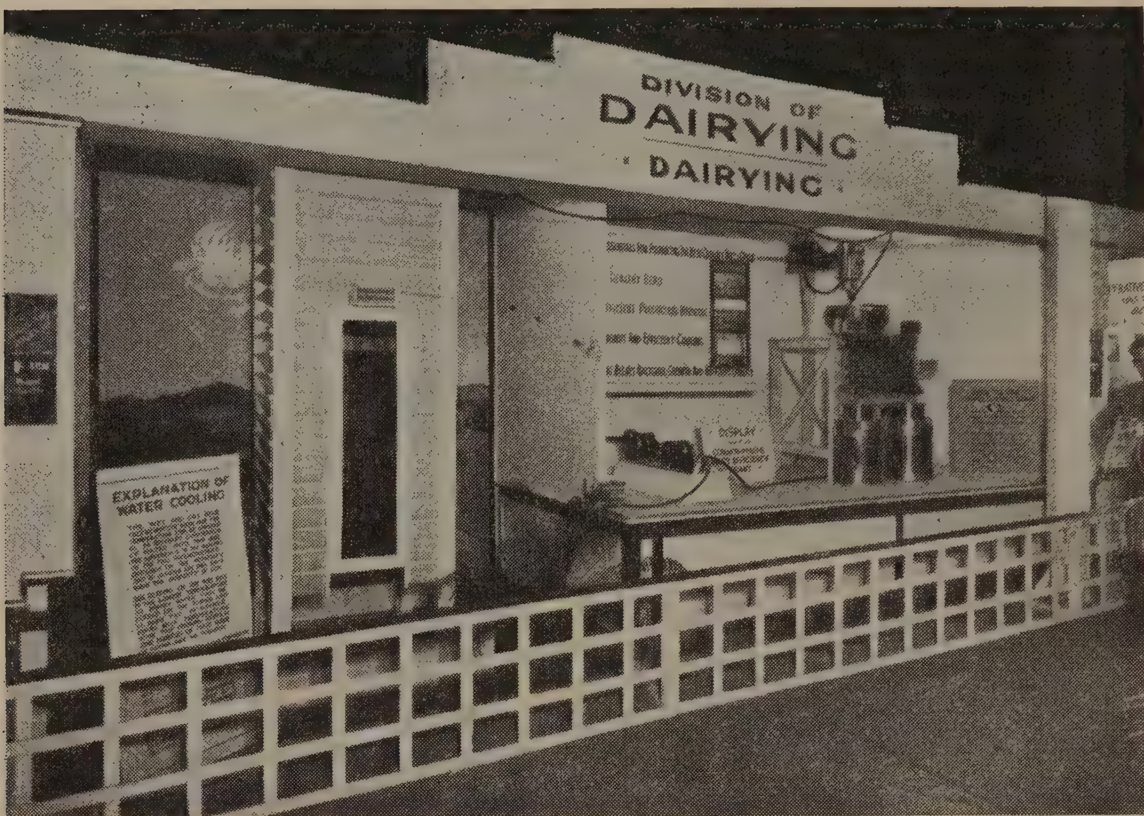
POULTRY MEAT TAINTED BY BHC-TREATED GRAIN.

Tests carried out by the Poultry Branch of the Department of Agriculture and Stock have shown that the flesh of fowls fed on grain treated with the commercial grade of the insecticide benzene hexachloride (BHC) may have a musty flavour when the birds are slaughtered.

BHC has proved to be very effective in protecting wheat, maize and other grains against insect damage. It is compulsory to use it on hybrid maize, grain sorghum and French bean seed submitted for certification, and in view of the current shortage of carbon bisulphide some other grain is also being treated with this insecticide. While it in no way harms grain intended for sowing, it should not be used on grains which are to be fed to poultry, as in addition to its flesh tainting properties it may also give eggs a musty flavour.

There is some evidence that milk may be tainted, and so it is tentatively recommended that BHC-treated grain be not fed to milking cows.

Deodorised BHC is marketed by the trade, but its use as an insecticide in stored grain appears to be too costly where a large quantity of grain is concerned.



A Tower Recirculated Water Cooling System was Operated by the Division of Dairying to Demonstrate this Method of Milk and Cream Cooling to Show Visitors.

The Main Features of the Cattle Husbandry Branch's Show Display were the Parts that Dehorning, Pest Control and Crop Fattening Play in Improving Beef Production.

ANIMAL HEALTH

Infectious Calf Pneumonia.

O. H. BROOKS, Divisional Veterinary Officer.

THIS disease has been known to exist for a considerable period, but appears to have become more widespread during recent years. Losses of up to 75 per cent. of calves have sometimes occurred, due in many cases to sickness and deaths continuing for several weeks before the disease has been diagnosed correctly.

The primary infection is thought to be caused by a virus, which acting in conjunction with other infective agents causes pneumonia.

Source of Infection.

The introduction of infectious pneumonia usually follows close contact with "carriers" or infected surroundings. Calves that recover from pneumonia may remain infectious for a long period even though they appear to be healthy.

Infection escapes from the lungs of affected animals in the breath, nasal discharges, and dung. Close contact allows the infection to be carried in the air from one animal to another.

Drinking vessels become contaminated when infected animals are swallowing, as infectious discharge flows from the nostrils.

Calf pens may become heavily contaminated and if in shaded surroundings, can be a source of infection for long periods. Exposure to sunlight will destroy infection.

Plate 102.

Calves Suffering From Infectious Pneumonia.

Susceptibility of Calves.

Calves from a few weeks to six months of age are susceptible to infectious pneumonia. The most susceptible age appears to be about three weeks, after which there is an increasing resistance to infection, although losses do occur among calves that have been weaned. Some calves, irrespective of age, have a natural resistance and do not become infected.

The disease may cause death within a short period, or develop into a chronic sickness which leaves the calf stunted and unthrifty. When an outbreak occurs, the majority of calves of the susceptible age may show evidence of infection. Calves having a high degree of resistance to the disease return to normal within a few days, while those with a low resistance due to faulty feeding, malnutrition or exposure develop pneumonia. The percentage of deaths will depend upon the severity of the infection, and the degree of resistance of the calf. In some herds, only odd sporadic cases occur. More often many calves are affected and about half of them die, while those that recover suffer a serious setback for weeks or months.

Symptoms.

Infectious pneumonia may occur in acute, sub-acute and chronic forms, depending on the severity of the infection, the duration of the sickness, and the susceptibility of calves. In the acute form calves may die within 48 hours of the first noticeable symptoms. When the disease first makes its appearance in this form, it may be mistaken for other diseases such as blackleg and poisoning. Sub-acute cases develop typical symptoms, and death may follow a sickness of several days' duration. Calves affected with the chronic form become weak and stunted and usually have to be destroyed.

In the early stages of the disease calves are usually thirsty and have poor appetites as the result of a high temperature (104-105 deg.). The calf becomes dull, and usually segregates itself from the mob. There is a watery discharge from the eyes, and a mucous discharge from the nostrils may form a crust-like scab on the muzzle.

Pneumonia causes abnormal breathing, with exaggerated flank movement. Abnormal noises may be detected within the chest cavity. Severely affected calves cough frequently, while milder cases may cough only occasionally, more especially when disturbed. The cough is husky and is usually followed by a discharge of thick mucus from the nostrils.

Calves lose condition rapidly (Plate 102) and become very weak. It is usual for indigestion to occur, resulting in a white foul-smelling scour, which becomes matted on the hair of the tail. In some cases blood is passed in the faeces.

Post-mortem Findings.

Healthy lung has a glistening smoothness, a salmon pink colour, a spongy inflated texture, and will float on water.

When the lung becomes inflamed and ceases to perform its normal function, it is referred to as pneumonic. Infection of the lung causes inflammation of the air passages and congestion of the lung tissue. Secondary infection causes a breakdown in the spongy structure.

Pneumonic lung in the early stages is dark red in colour, firm or solid, heavier than normal, and will sink in water. Older lesions become grey to creamy white in colour, with a sharp demarcation between the pneumonic and healthy lung (Plate 103).

All or portion of both lungs may be affected with pneumonia. However, it is usual to find lesions confined to the front lobes and the lower borders of the lung, with one lung affected more than the other.

Plate 103.

Post-mortem Appearance of a Pneumonic Lung. In the left-hand picture, an infected lung is shown in the thorax, lying between the steel and the knife. In the other picture, the pneumonic lung is held in the right hand and a normal lung in the left, with the heart between.

There is usually an excessive quantity of fluid in the chest cavity, resulting from pleurisy, and the lungs may adhere to the chest wall. The heart sac may also be distended with excess fluid. In chronic cases the lung tissue usually contains many small abscesses the pus in which is creamy yellow in colour.

The lymph glands at the base of the windpipe where it divides are usually swollen and juicy. The liver becomes dark red or purple, and there may be many small haemorrhages in the kidney due to toxaemia.

Diagnosis.

When pneumonia first makes its appearance, deaths may be confused with other conditions such as "white scours," lung worm infestation and poisoning depending upon the form of the disease experienced. A diagnosis can be made by doing a post-mortem examination, when lesions of pneumonia can be easily seen and felt.

Lung worms may be responsible for chronic coughing but do not of themselves cause pneumonia. Their presence in the lung is, however, often followed by pneumonia because of the irritation set up.

If there is any doubt about the diagnosis or action to be taken to control an outbreak, a private veterinarian or officer of the Department of Agriculture and Stock should be consulted.

Treatment.

Certain sulphonamide drugs are effective for treating infectious pneumonia provided treatment is commenced in the early stages of the disease and the proper dose, according to the weight of the calf, given regularly each day for the prescribed period. These drugs are restricted under a provision of the Health Acts, so it is necessary to have a prescription from a veterinary surgeon before they can be purchased.

Sulphamezathine is the preferred drug. Sulphamerazine is almost, if not equally as good, while sulphapyridine has also given satisfactory results. The recommended treatments are—

(*a*) Sulphamezathine or sulphamerazine in the form of powder or 0.5 gram tablets administered once daily by mouth as follows:—1st day—1 gram for each 10 lb. liveweight; 2nd to fourth days—1 gram per 15 lb. liveweight.

(*b*) Sodium sulphamezathine in the form of $33\frac{1}{3}$ per cent. solution, to be injected subcutaneously once daily at the rate of 3 c.c. per 15 lb. liveweight for three or four days.

(*c*) Sulphapyridine in the form of powder or 0·5 gram tablets administered by mouth at the rate of 1 gram per 20 lb. liveweight per day, divided into two doses (morning and evening) each day. The initial dose should, however, be a full dose.

Treatment is given for three or four days.

The sodium sulphamezathine solution is available in bottles containing 100 c.c. or 500 c.c. of sterile solution. It is injected with a sterile syringe of from 10 c.c. to 20 c.c. capacity (Plate 104). By inserting a sterile needle through the thin rubber stopper, the solution can be withdrawn directly into the sterile syringe (Plate 105).

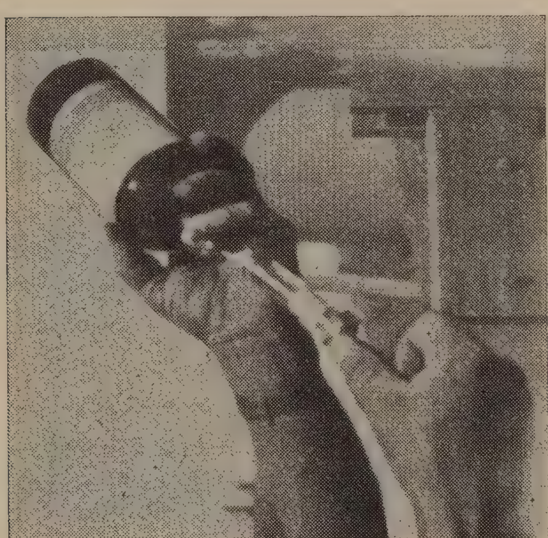


Plate 104.

Method of Injecting Sodium Sulphamezathine Under the Skin.

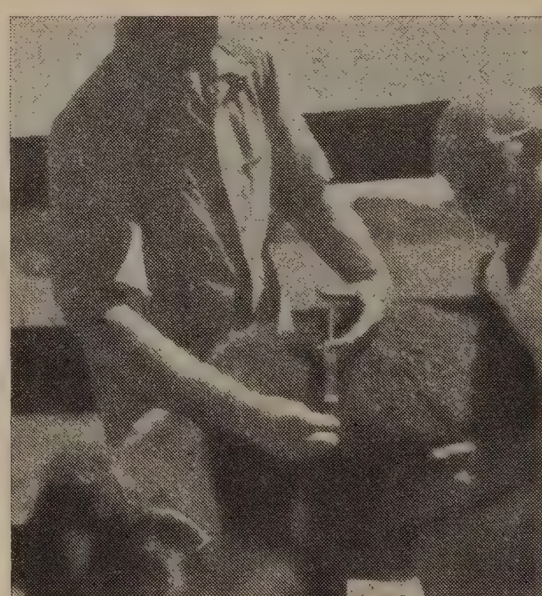


Plate 105.

Withdrawing Sodium Sulphamezathine Solution from the Bottle into a Syringe.

There are several ways of giving the treatments that are administered by mouth. The best method is to mix the powder or crushed tablets with milk or water, and give as a drench.

When drenching, the head should not be held higher than necessary, otherwise the dose may pass directly into the windpipe, and thus cause further irritation to the lung.

Ample water should be available at all times. Treatment for longer than five to seven days is not justified.

How to Deal with an Outbreak.

Early recognition and treatment will minimise losses and prevent calves from becoming weak and stunted. If the disease is well established, the treatment of all calves in a group may be justified, irrespective of typical symptoms of pneumonia being present. This course is commonly adopted to bring the disease under control promptly. While undergoing treatment, sick calves should be segregated, preferably in a hospital pen. Weak and stunted calves with chronic lesions of pneumonia seldom respond to treatment. Carcasses should be burned or buried.

In conjunction with medicinal treatment, calves should be protected and nourished to increase their resistance and ability to repair damaged tissue. Vitamin A supplements in the form of cod liver oil will assist to strengthen the resistance of the calf. Green feed is also a very useful source of this vitamin.

In the event of scouring being a feature, special care will have to be taken in feeding the ration of milk. No special medicinal treatment is necessary to treat the scouring.

When worm infestation is a complicating factor, treatment with phenothiazine should be given after the course of treatment for pneumonia. As worm control is primarily a matter of pasture rotation and periodic treatment, the Departmental pamphlets on this subject should be consulted.

Prevention.

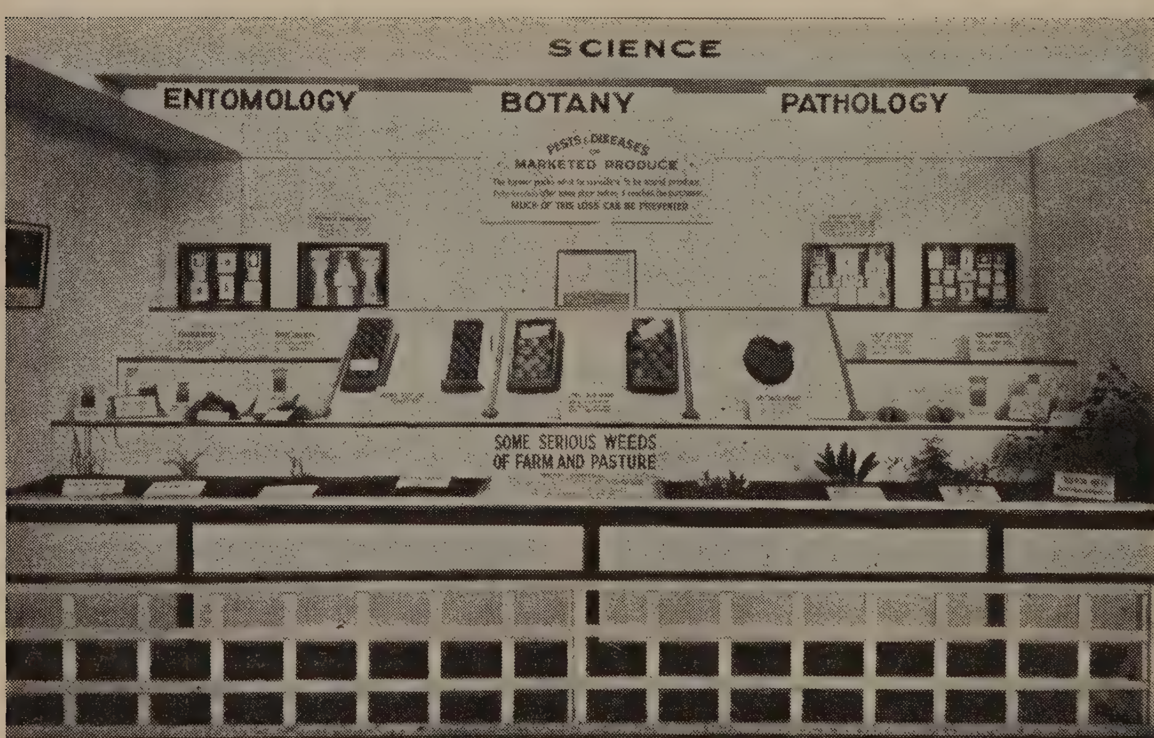
As calves often remain infectious following recovery from pneumonia even if they have been treated with sulphonamides, the only effective means of breaking the cycle of infection from older calves to younger calves is to segregate newborn calves in clean surroundings. Contact through a fence is sufficient to allow the spread of infection. Separate drinking vessels should be available, owing to infection being carried by nasal discharges.

Pens in which cases of pneumonia have occurred should be cleaned and paddocks spelled for at least one month before being used for younger calves. Shelter sheds should be exposed to sunlight, as this is the best disinfectant. While iron and cement surfaces can be disinfected with 5 per cent. lysol or 0·5 per cent. caustic soda, germs cannot be killed readily in wood, soil or organic matter by this means. Wooden troughs should be discarded unless made of sawn and dressed hardwood.

The rearing of well nourished calves will increase their resistance to this disease. An article on the feeding requirements of dairy calves, which appeared in the April issue of this Journal, should be read in conjunction with this article. Vaccination has not been found effective as a preventive.

Care should be exercised when purchasing calves. Dipping of calves at a community dip may be the means of spreading this disease during an epidemic in a district.

The Important Part Played by the Co-operative Movement in the Marketing of Queensland Produce Was Chosen for its Theme by the Marketing Branch.



Prevention of Wastage in Fruit, Vegetables and Grains After Harvest Was the Main Feature of the Science Branch's Exhibit, with Important Weeds Also to the Fore.

The 1951 Pig Meats Carcass Competitions.

F. BOSTOCK, Officer-in-Charge, Pig Branch, and Competition Judge.

THE Australian Meat Board, in association with the Department of Agriculture and Stock and with the co-operation of all sections of the industry, conducted Baconer Pig Carcass Competitions this year for the fourth time.

Judging and field days in the four competition districts were as follows:—

District.	Centre.	Date.
Northern ..	Mareeba ..	May 14
Central ..	Rockhampton ..	May 17
Darling Downs ..	Toowoomba ..	May 23
South Queensland ..	Brisbane ..	May 30

Prize Winners.

The State championship was awarded to Mr. E. B. Tumbridge, of the Downs district, for a purebred Berkshire pig which scored 87·5 per cent. The carcass, of 133 lb. dressed weight, was of good type, scoring well in all points. It had a well-developed eye muscle (27 out of 28), an even covering of fat (19 out of 20), good body length (19 out of 20), very fair streak development (7½ out of 12), and good-type shoulder (6½ out of 7), and ham (6½ out of 8), but was a little long in the leg, scoring only two points out of five.

Prize winners in their respective districts were as follows:—

Prize.	Owner.	Breed.	Weight. Lb.	Points.
		Northern.		
1st ..	J. S. Stimson	Tamworth x Berkshire ..	160	83½
2nd ..	Drury Bros.	Berkshire	120	80½
3rd ..	Wm. Hastie and Sons ..	Berkshire	134	80
		Central.		
1st ..	A. W. Davey	Berkshire x Large White ..	139	87
2nd ..	V. E. Jones	Berkshire	152	83
3rd ..	A. W. Davey	Berkshire x Large White ..	158	82½
		Darling Downs.		
1st ..	E. B. Tumbridge	Berkshire	133	87½
2nd ..	L. Puschmann	Large White x Berkshire ..	166	81½
3rs ..	F. L. Hayward and K. A. Temple	Large White	162	80½
		South Queensland.		
1st ..	B. A. Schellback	Berkshire	164	82½
2nd ..	A. E. A. Holmes	Large White	166	81
3rd ..	Queensland Agricultural High School and College	Berkshire	149	80

Plates 106-110 show prizewinning and other carcasses.

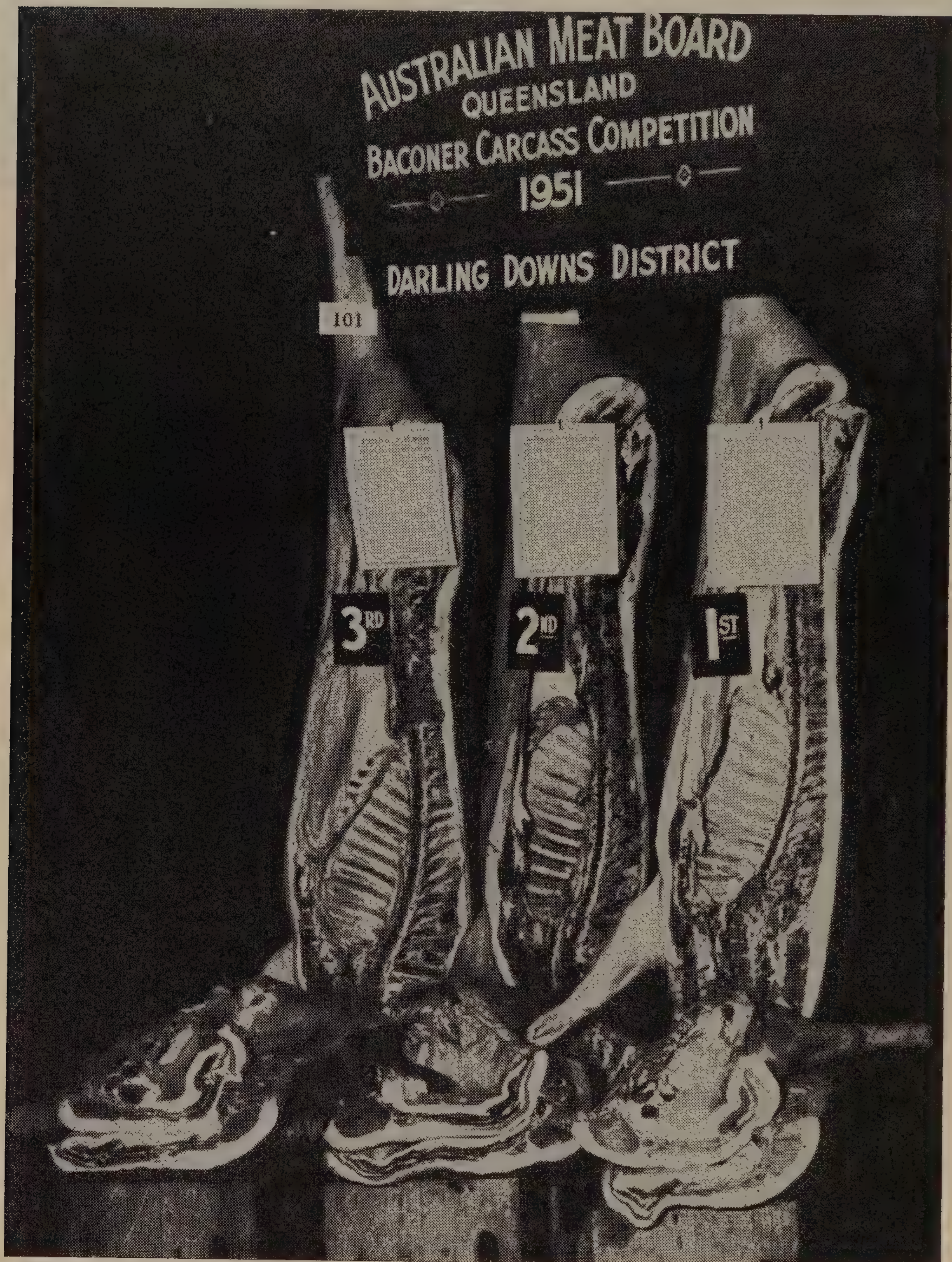


Plate 106.

Prizewinners in the Darling Downs District. The State champion carcass is on the right.

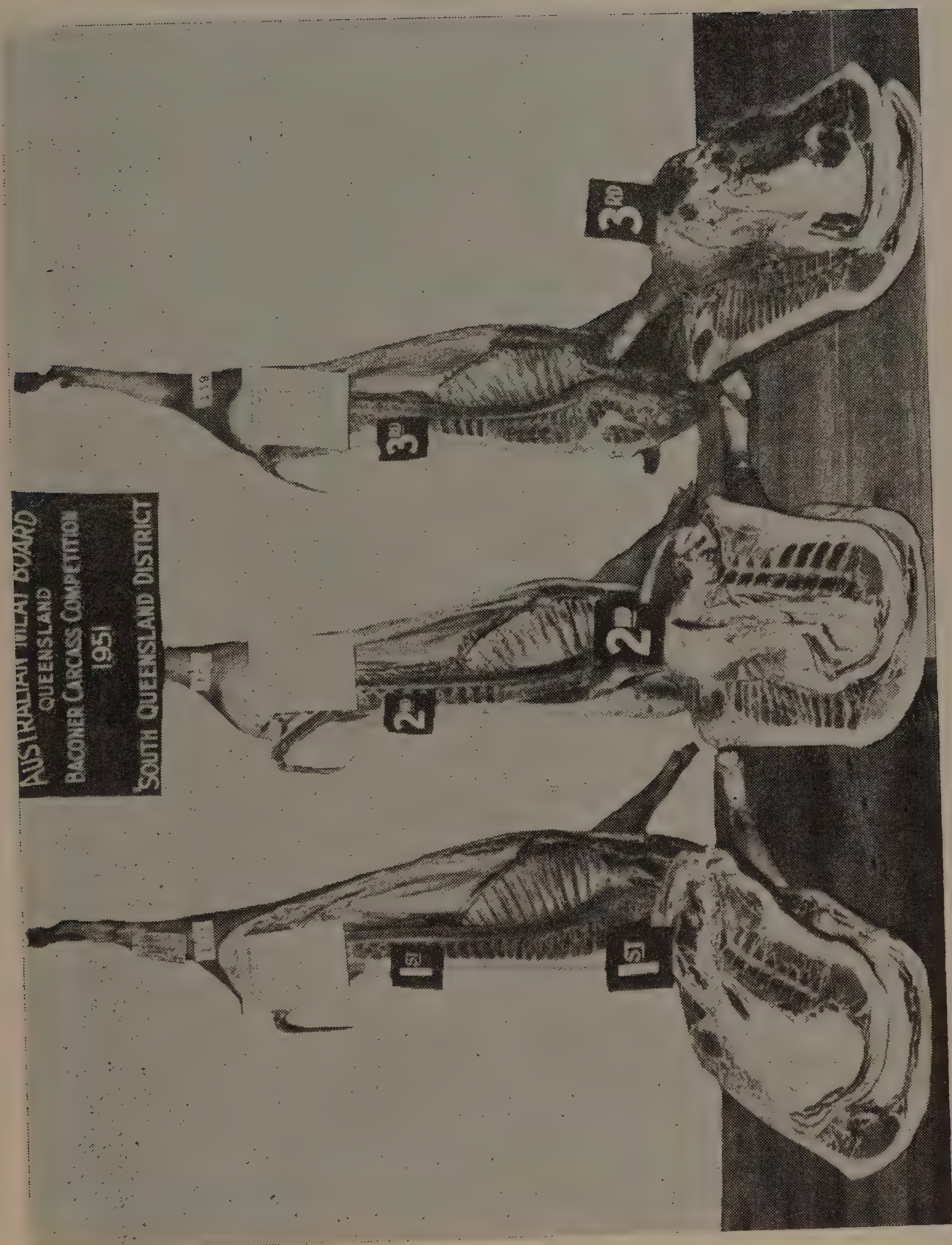


Plate 107.

Prizewinners in the South Queensland District.

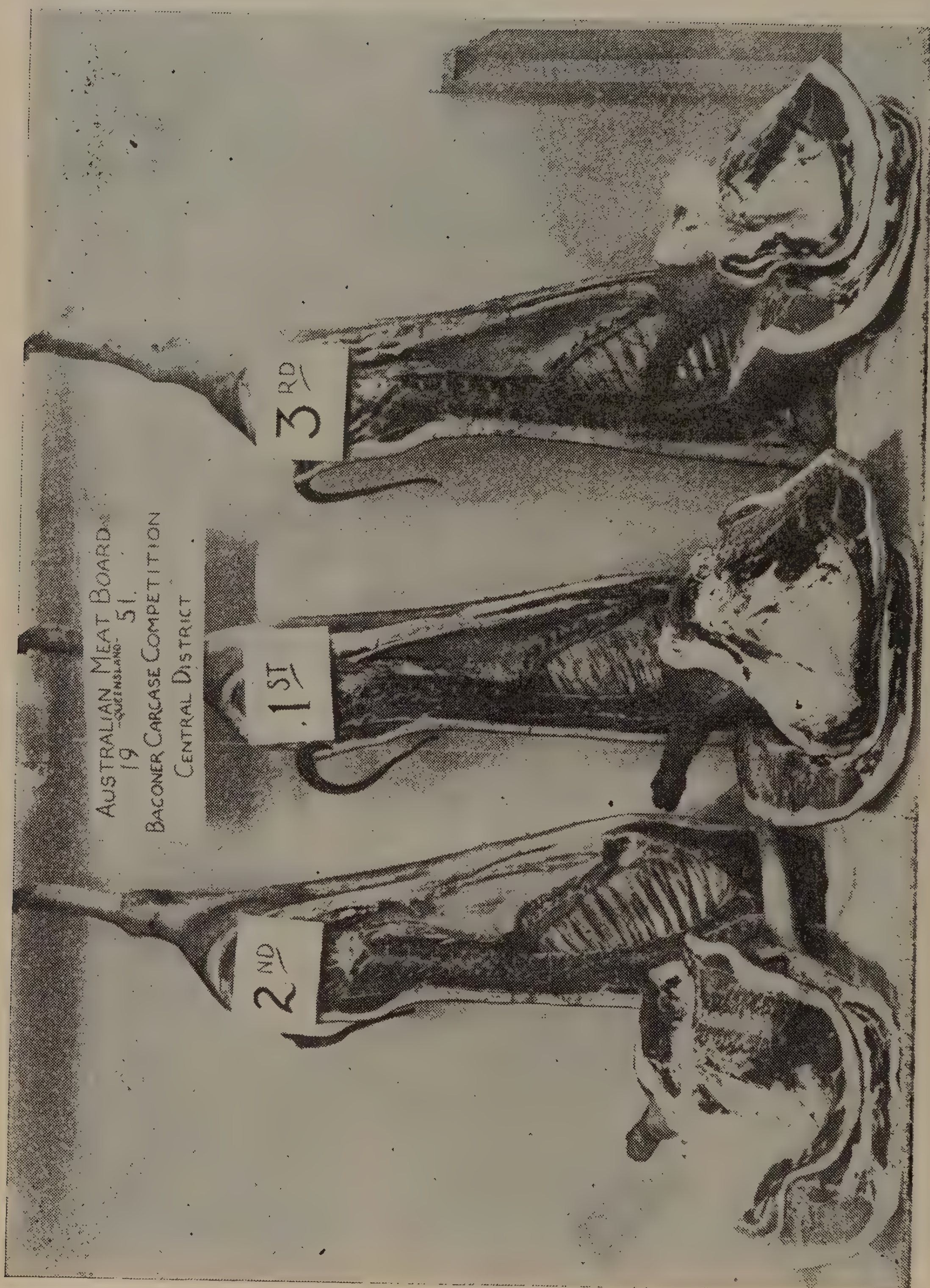


Plate 108.

Prizewinners in the Central District.

Plate 109.

Prizewinners in the Northern District. Left to right—1st, 2nd and 3rd.

Plate 110.

A General View of the Carcasses Entered in the Darling Downs District.

Field Days.

Field days were arranged to coincide with the judging at each district centre and it was very pleasing to note that farmers gave good support by attending in numbers. This was especially so at Rockhampton, where approximately 225 attended. Every effort was made by officers of the Department of Agriculture and Stock, together with the Works management at each centre, to make these field days as instructive and interesting as possible. Farmers attending were not only given the opportunity of seeing the type of carcass entered in the competitions but were able to inspect the bacon factory or meatworks and to listen to addresses on subjects dealing with pig production and farming generally.

Comments on Entries.

To qualify for entry into the competition, the pig in the first place had to be sired by a purebred boar and the dressed carcass had to weigh between 120 lb. and 180 lb. Unfortunately 13 carcasses of the 141 submitted were either over or under the above weights. The total of 128 carcasses eligible for competition was 25 more than in the previous year.

An improvement in quality was again noted, suggesting that competing farmers had benefited from past experience and utilised to advantage information and knowledge gained at previous field days and through the display of score cards. The average score of 71·566 per cent. represented a considerable improvement on last year's results. However, while it is pleasing to note an improvement in the majority of sections, there was a loss of points in one very important point—body length. Producers should pay strict attention to this when selecting breeding stock.

The following comments are made on the various items on the score card.

Hams averaged 80·517 per cent., an improvement of 4·304 per cent. This improvement is gratifying when it is realised that the ham is one of the highest priced cuts, but farmers should continue to select breeding stock showing good development of hams in order to further improve this feature.

Shoulders scored an average of 84·598 per cent., an increase of ·934 per cent. This score is good and breeders apparently realise the importance of light shoulders, but careful selection will have to be maintained if shoulder quality is to be held at a satisfactory level.

Streak or belly did not score quite so well as last year, securing 61·784 per cent. (2·940 per cent. lower). There were several very good streaks among the entries, but more careful feeding and selection will have to be practised, because a streak which is thick and contains a large percentage of meat adds value and appearance to the bacon rasher.

Eye muscle scored very well, averaging 71·958 per cent., an increase of 21·022 per cent. on last year's low score. It is pleasing to note that producers have given this section attention and that their efforts have been so successful. However, there is still room for improvement and producers are again advised to be careful in the selection of breeding stock and to pay particular attention to feeding, especially just before weaning and on to light porker weight.

Backfat development was good, with a score of 77·226 per cent., an increase of 4·362 per cent. over the previous year. This improvement in backfat was due to selection and feeding rather than to the submission of lighter weight pigs. The entries showed again that Queensland farmers can produce a first quality carcass, not overfat, and as overfatness is still causing concern to bacon factories in the central and southern parts of the State, it is hoped that farmers will be guided by the experience gained and market pigs in prime condition.

Body length did not score as well as in the previous year, the average being 64·922 per cent., a loss of 2·019 per cent. Short body length was the most noticeable feature at all centres and emphasises the necessity for selecting breeding stock of good length. Feeding also plays its part, and rations must be properly balanced if good body length is to be retained in our pigs.

Leg length, which gives an indication of the quantity of bone contained in the carcass, was very fair, although the average score (64·218 per cent.) was 1·413 per cent. below last year's.

The overall percentage of 71·566 per cent., an increase of 6·348 per cent. on last year, represents a praiseworthy effort on the part of producers in all districts. A point worthy of mention is the fact that in no district was the score secured for 1st, 2nd and 3rd place below 80 per cent. If farmers will continue to pay attention to the careful selection of breeding stock of the right type and give consideration to the rations fed, the objective of these competitions—namely, an improvement in the type and quality of pigs forwarded for slaughter throughout the State—will be realised.

The English or Hammond System of carcass appraisal was used, and the average points for each section of judging are as follows:—

—	Possible Points.	Average Points Obtained.	Percentage of Possible Points, 1951.	Percentage of Possible Points, 1950.
By Inspection—				
Hams	8	6·441	80·517	76·213
Shoulders	7	5·921	84·598	83·664
Streak	12	7·414	61·784	64·724
By Measurement—				
Eye Muscle	28	20·148	71·958	50·936
Backfat Thickness ..	20	15·445	77·226	72·864
Body Length	20	12·984	64·922	66·941
Leg Length	5	3·210	64·218	65·631
Total	100	..	71·5566	65·218

A Reminder to the Pig Raiser that Carcass Requirements Change with Time was Given by the Pig Branch at the Brisbane Show, while 50 Years of Progress in Incubation of Eggs was the Theme of the Poultry Branch.

Brucellosis Testing of Swine.

The Department of Agriculture and Stock is operating a scheme whereby pig herds are tested at intervals for the occurrence of swine brucellosis (contagious abortion).

A herd listed by the Department as "brucellosis tested" is one in which all such animals as may be determined by the Director of the Department's Division of Animal Industry have been subjected to two successive tests for brucellosis, at intervals determined by him, without any positive reactors being found.

In order for a herd to be retained on the list of Tested Herds, a semi-annual or annual re-test of the herd, as determined by the Director, is required. If at a re-test any animal gives a positive reaction to the test the herd is removed from the list; it is not listed again until subsequent tests, as determined by the Director, have been carried out.

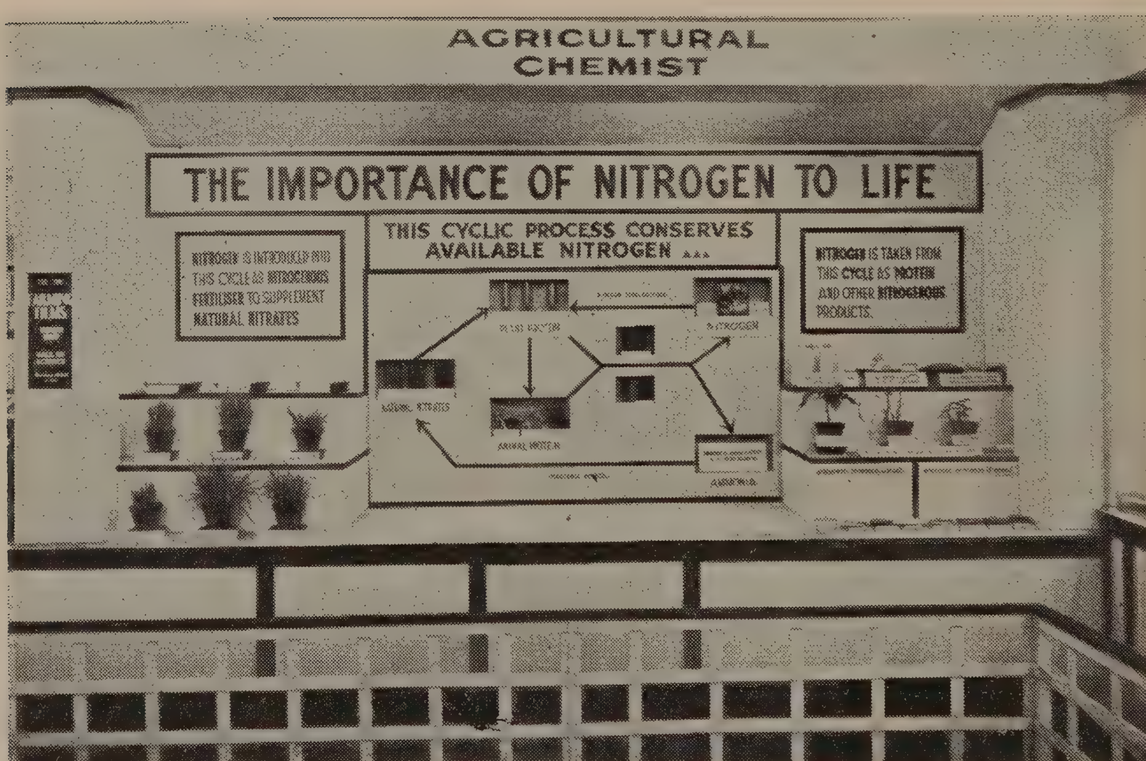
Full particulars of the Brucellosis Testing of Swine and application forms may be obtained from the Under Secretary, Department of Agriculture and Stock, William Street, Brisbane.

TESTED HERDS.
(AS AT 20th AUGUST, 1951.)

Breed.	Owner's Name and Address of Stud.
Berkshire	S. S. Ashton, "Scotia" Stud, Pittsworth
	J. J. Bailey, "Lucydale" Stud, East Greenmount
	S. Cochrane, "Stanroy" Stud, Felton
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	G. Handley, "Handleigh" Stud, Murphy's Creek
	J. L. Handley, "Meadow Vale" Stud, Lockyer
	R. G. Koplick, "Melan Terez" Stud, Rochedale
	H. V. Littleton, "Wongalea" Stud, Crow's Nest
	O'Brien and Hickey, "Kildurham" Stud, Jandowae East
	E. Pukallus, "Plainby" Stud, Crow's Nest
	G. C. Traves, "Wynwood" Stud, Oakey
	E. Tumbridge, "Bidwell" Stud, Oakey
	Westbrook Farm Home for Boys, Westbrook
	H. W. Wyatte, Rocky Creek, Yarraman
	H. M. State Farm, "Palen Creek," Palen Creek
	A. R. Ludwig and Sons, "Cryna" Stud, Beaudesert
	H. H. Sellars, "Tabooba" Stud, Beaudesert
	F. Thomas, "Rosevale" Stud, Beaudesert
	Bowkett and Meacle, "Myola Vale" Stud Piggery, Burra Burri, Jandowae
	D. T. Law, Trouts Road, Aspley
	R. J. McCullough, "Maxholm" Berkshire Stud, Gatton
	C. F. W. and B. A. Schellback, "Redvilla" Stud, Kingaroy
	R. H. Crawley, "Rockthorpe" Stud, *via* Pittsworth
Large White	H. J. Franke and Sons, "Delvue" Stud, Cawdor
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	F. L. Hayward, "Curyo," Jandowae
	J. A. Heading, "Highfields," Murgon
	K. B. Jones, "Cefn" Stud, Pilton
	R. G. Koplick, "Melan Terez" Stud, Rochedale
	R. Postle, "Yaralla" Stud. Pittsworth
	E. J. Bell, "Dorne" Stud, Chinchilla
	M. E. Myers, Halpine Plantation, Kallangur
	L. C. Lobegeiger, "Bremer Valley" Stud, Moorang, *via* Rosewood
	J. H. G. Blakeney, "Talgai" Stud, Clifton
	V. P. McGoldrick, "Fairymeadow" Stud, Cooroy

TESTED HERDS—continued.

Breed.	Owner's Name and Address of Stud.
Tamworth	S. Kanowski, "Miecho" Stud, Pinelands
	N. R. Potter, "Actonvale" Stud, Wellcamp
	D. F. L. Skerman, "Waverley" Stud, Kaimkillenbun
	A. C. Fletcher, "Myola" Stud, Jimbour
	L. C. Lobegeiger, "Bremer Valley" Stud, Moorang, *via* Rosewood
	P. V. Campbell, Lawn Hill, Lamington
	Salvation Army Home for Boys, Riverview
	F. Thomas, "Rosevale" Stud, Beaudesert
	A. J. Surman, Noble Road, Goodna
	P. V. McKewin, "Wattleglen" Stud, Goombungee
Wessex Saddleback ..	W. S. Douglas, "Greylight" Stud, Goombungee
	K. Day and P. Hunting, "Kazan" Stud, Goodna
	E. Sirrett, "Iona Vale" Stud, Kuraby
	C. R. Smith, "Belton Park" Stud, Nara
	H. H. Sellars, "Tabooba" Stud, Beaudesert
	H. Thomas, "Eurara" Stud, Beaudesert
	D. T. Law, Trouts Road, Aspley
	G. J. Wilson, "Glenbella" Stud, Silverleigh
	G. J. Cooper, "Cedar Glen," Yarraman



The Cycle of Nitrogen in Nature Was Traced by Flashing Lights in this Display of the Chemical Laboratory.

ASTRONOMICAL DATA FOR QUEENSLAND.

OCTOBER.

Supplied by W. J. NEWELL, Hon. Secretary of the Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			MINUTES LATER THAN BRISBANE AT OTHER PLACES.					
Day.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	5·29	5·47	Cairns ..	36	22	Longreach	38	31
6	5·23	5·49	Charleville ..	28	26	Quilpie	34	36
11	5·18	5·52	Cloncurry	55	45	Rockhampton ..	13	7
16	5·13	5·55	Cunnamulla ..	29	30	Roma	18	16
21	5·07	5·58	Dirranbandi ..	18	20	Townsville ..	30	19
26	5·03	6·01	Emerald	22	16	Winton	44	36
31	5·00	6·04	Hughenden ..	40	30	Warwick	3	4

TIMES OF MOONRISE AND MOONSET.

At Brisbane.

Day.	Rise.	Set.
	a.m.	p.m.
1	5·16	5·59
2	5·48	7·00
3	6·22	8·04
4	7·02	9·11
5	7·48	10·19
6	8·42	11·25
7	9·42	..
		a.m.
8	10·48	12·25
9	11·56	1·19
	p.m.	
10	1·03	2·06
11	2·09	2·46
12	3·11	3·21
13	4·12	3·53
14	5·11	4·25
15	6·11	4·56
16	7·11	5·29
17	8·10	6·05
18	9·09	6·45
19	10·06	7·29
20	10·59	8·17
21	11·47	9·10
22	..	10·05
	a.m.	
23	12·30	11·01
24	1·08	11·57
		p.m.
25	1·42	12·53
26	2·14	1·49
27	2·44	2·46
28	3·14	3·43
29	3·45	4·44
30	4·18	5·48
31	4·57	6·55

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

Charleville 27; Cunnamulla 29; Dirranbandi 19; Quilpie 35; Roma 17; Warwick 4.

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Day.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	20	16	36	32	11	8	42	36
6	30	9	46	23	21	0	54	26
11	24	13	40	29	15	3	46	32
16	13	25	28	41	3	16	31	48
21	9	30	25	45	0	21	26	54
26	14	23	30	39	5	14	34	44
31	26	12	43	26	18	1	50	29

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	32	23	52	45	36	30	26	20
3	43	11	60	38	45	23	36	11
5	53	3	67	32	50	18	44	4
7	56	3	68	32	52	18	46	4
9	52	5	66	34	50	20	43	6
11	41	14	57	40	42	25	34	14
13	29	31	50	52	35	37	25	27
15	18	38	42	56	27	41	16	33
17	8	48	36	62	21	48	8	40
19	2	55	33	67	17	52	3	45
21	3	56	34	67	18	53	4	46
23	6	50	35	63	20	49	6	42
25	14	42	39	59	24	44	13	36
27	24	31	46	52	31	37	21	27
29	35	20	54	44	39	29	29	18
31	46	8	62	36	47	21	38	8

Phases of the Moon.—New Moon, October 1st, 11.57 a.m.; First Quarter, October 8th, 10.00 a.m.; Full Moon, October 15th, 10.51 a.m.; Last Quarter, October 23rd, 9.55 a.m.; New Moon, October 30th, 11.54 p.m.

On October 15th the sun will rise and set about 10 degrees south of true east and true west respectively, and on the 13th and 28th the moon will rise at true east.

Mercury.—At the beginning of the month, in the constellation of Leo, will rise 20 minutes before the sun. After the 13th it will pass into the evening sky and by the end of the month, in the constellation of Libra, will set 50 minutes after sunset.

Venus.—Now a conspicuous object in the eastern morning sky, rising 2 hours before the sun at the beginning of October and reaching greatest brilliancy on the 10th. By the end of the month it will rise 2¼ hours before the sun.

Mars.—Not far from Venus but much fainter than that planet and higher above the horizon. It will rise 2 hours 10 minutes before the sun on the 1st and on the 3rd will pass close to the star Regulus in the constellation of Leo. On the 27th the moon will pass between Mars and Venus, Mars being on the north and Venus on the south. At the end of the month Mars will rise 2 hours 24 minutes before sunrise.

Jupiter.—In the constellation of Pisces, at the beginning of the month will rise just before sunset and will be seen the whole night. By the end of the month it will rise during the afternoon daylight hours and set about 1½ hours before sunrise.

Saturn.—Too close in line with the sun to be seen at the beginning of October, but by the end of the month will rise 1¾ hours before the sun.

THE CONSTELLATIONS.

AQUILA, SCUTUM AND SAGITTA.

Adjoining Ophiuchus and Serpens, north of the Equator, is the constellation of Aquila (the Eagle), said to represent the eagle sent by Jupiter to bring Ganymede to be cup bearer to the gods on Mount Olympus. Much of the constellation lies in the Milky Way and the brightest star, Altair, is a very fine first magnitude white star flanked on opposite sides by fainter stars, Beta and Gamma, the group making a pattern something like the stars of Orion's "belt." About 15 degrees west and 8 degrees south of Altair there appeared a very bright nova in 1918. It reached a maximum brightness of —1.4 magnitude (almost as bright as Sirius) and was the brightest nova recorded since Kepler's nova of 1604. About six months after this nova outburst, a faint greenish gaseous envelope could be seen in the telescope. Since then this "shell" has been expanding at the rate of about 2 seconds of arc per year.

Though this region of the sky is very rich in double stars, variables, nebulae, &c., there are no particularly bright stars, except Altair, from the South Pole regions to well down on the northern horizon and from Ophiuchus eastward to the "Great Square" of Pegasus. Standing out so bright against the background of fainter objects, Altair and thus Aquila are easily identified.

Bordering Aquila and situated between Serpens and Sagittarius is the small modern constellation of Scutum (the Shield) lying almost entirely in the Milky Way in the region of its greatest density of stars. The constellation was made by Hevelius late in the seventeenth century. Photographs of this area clearly show the many star clouds and on pictures 12 inches by 12 inches more than 2,000,000 stars are recorded. Being of modern origin, there is no recognized symbol.

On the north of Aquila is the faint constellation of Sagitta (the arrow), previously called Alahance. The Milky Way also traverses this group and consequently many interesting telescopic objects are to be found there.

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DEPARTMENT OF AGRICULTURE

QUEENSLAND AGRICULTURAL JOURNAL

Ellendale Mandarins in a Gayndah Orchard.

LEADING FEATURES

Cotton Varieties

The Papaw

Potato Tuber Moth Control

Elevated Milking Bails

Liver Fluke of Sheep

Registered at the General Post Office, Brisbane, for transmission by Post as a Newspaper.

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Edited by
C. W. WINDERS, B.Sc.Agr.

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7

Contents

The Cotton Varietal Position In Queensland.

R. W. PETERS, Plant Breeder, Agriculture Branch.

COTTON has been grown commercially in Queensland at intervals since 1860, but it was not until 1920 that the present phase of cotton growing originated under a system of Federal and State guaranteed prices. The type of cotton seed available for planting purposes at that time was of very mixed origin, embracing such divergent types as Sea Island, Egyptian, and various American upland varieties. This seed was distributed to farmers and in succeeding years became hopelessly mixed both in the ginning operations and through cross-pollination in the field.

INTRODUCTION OF NEW VARIETIES.

The urgent need for introducing pure seed of suitable varieties was recognised by the Queensland Department of Agriculture and Stock. At the same time it was realised that the greatest precautions were necessary to prevent the introduction of pests and diseases with the imported seed. It was decided, therefore, to import only small quantities and to grow them under strict quarantine conditions before releasing them into the main cotton growing areas of the State.

The climatic and soil conditions over most of the Queensland cotton belt are similar to those ruling in many parts of the cotton growing areas of the United States of America where the bulk of the American upland cottons are grown. These cottons, with their large bolls and heavy bodied fibres, can be picked and ginned much more economically than the smaller bolled, finer fibred cottons of Sea Island and Egyptian types, for which there is only a limited market. The varieties of cotton introduced and grown in Queensland are therefore all of the American upland type, and are grouped botanically under *Gossypium hirsutum.* Since 1923 numerous varieties of this type of cotton have been introduced and tested over the main cotton growing areas of Queensland. Many gave little promise of being suitable for local conditions, while others, though promising in the first few years,

later exhibited serious faults and were eliminated from further consideration. However, several varieties showing suitability for each of the main soil types on which cotton is grown in Queensland were available in the wide range of material introduced.

PLANT BREEDING AND PURE SEED SUPPLIES.

An upland cotton variety is not necessarily a fixed entity, but usually comprises a number of closely similar lines or strains. When such a variety is taken from one environment to another, for example, from the United States to Australia, the differences between many of these component strains may be accentuated. Thus there is a tendency for a newly introduced variety to separate into various types some of which may be superior (and others inferior) to the average type for that variety.

Careful selection work made within the variety after the breaking-up into a number of types has taken place may produce a strain well adapted to the new regions in which it is being grown. This improvement in cotton by selection has been carried out in Queensland by officers of the Department of Agriculture and Stock on all promising imported varieties, with the result that improved types have been evolved in most of the commercial varieties grown, and more are still being developed.

Cotton is cross-pollinated easily and strict precautions have to be taken to prevent contamination between varieties. It is advisable, therefore, to isolate a variety being grown for pure seed purposes by at least half a mile from other cotton, and also to plant it on land not sown to cotton the previous year unless the previous variety was the same.

Care is likewise necessary at the ginneries to prevent an admixture of seed in the operations connected with the supply of pure seed. It is obviously desirable, therefore, to limit the number of commercial cotton varieties within a district to the lowest possible minimum. The ideal set-up would be to have one variety for each district, but soil variations usually make this impracticable in Queensland.

Even though isolation may be satisfactory and every care be taken at the ginneries, seed purity of cotton varieties tends to deteriorate. To meet this problem a systematic programme of plant selection is necessary in order to maintain a regular supply of good seed within each variety.

MECHANICAL HARVESTING.

The acute shortage of rural labour that has existed in Queensland in the last decade has been chiefly responsible for increasing interest in mechanical pickers for harvesting cotton, and this has necessitated some changes in plant selection objectives. Rank growth is undesirable because of the development of numerous vegetative branches, too many of which prevent the spindles of the picker engaging all the open bolls of seed cotton as they pass through the plant.

The ideal plant type for mechanical harvesting is one not exceeding five feet in height, which has an open habit of growth with the bolls arranged symmetrically over the plant (Plate 111). While specialized methods of cultivation can influence the production of this type of plant, more can be done by careful selection. Already some progress has been made in improving the varieties now being grown commercially, and in testing new varieties that were introduced recently for their potential suitability for machine harvesting.

Plate 111.

A Cotton Plant with Foliage Removed to Show Open Type of Branch Structure Suitable for Mechanical Harvesting.

SOILS.

The different types of soil that occur in Queensland and the climatic variations between seasons and between districts make it difficult to recommend the most suitable variety of cotton to grow. However, by a series of varietal tests carried out over a long range of years in the main cotton growing areas, it is now possible to indicate with some confidence the varieties which are likely to give good results on each of the major soil types on which cotton is grown.

It would appear that for rain-grown cotton the clay loams overlying a clay subsoil at a depth of 12 to 36 inches approach nearest to the ideal cotton soil. Grouped under this soil type may be classed the slopes originally timbered with ironbark (in some districts the broadleaf and in others the narrowleaf ironbark being used as the indicator), the lower slopes and flats associated with large box trees, and the well drained soils of the brigalow and brigalow-belah scrubs.

Other types of soil which will produce good yields of cotton, but are more subject to crop fluctuations caused by climatic variations, are the fertile loams and clay loams of the alluvial flats. Of these soils, the

heavier clay loams appear to be the most reliable though excellent yields of good cotton can be obtained on all if the recommended Rhodes grass—cotton rotation system is followed (Plate 112).

Plate 112.

Deteriorated Rhodes Grass Pasture on Brigalow-Belah Scrub Land. Breaking-up for cotton and later replanting with Rhodes grass is essential to maintain the productivity of such land.

The most unsuitable soils appear to be the deep red loams of the softwood scrubs and the deep sandy loams of the river and creek alluvials. Under irrigation the latter soils yield well, but under dry farming conditions are seriously affected by dry conditions and high temperatures.

Plate 113.

A Crop of Miller Cotton, Callide Valley.

COMMERCIAL VARIETIES.

Miller.

The Miller variety (Plate 113) is a big bolled, medium stapled American upland cotton which has been grown for many years in the United States of America. A new strain of it evolved in 1926 was introduced to Queensland in 1930.

The yielding ability, size of boll, ease of picking and the tendency of the variety to produce high grade cotton of a type required by the Australian spinners have made Miller popular wherever conditions are suitable for it. The average Miller plant is of medium size, with one to three basal vegetative branches, one or two of which may be fairly large. The foliage is medium to large in size, and dark green in colour. The main stem is usually erect and fairly tall and sturdy. The fruiting branches are numerous but only of medium length. The fruiting arrangement is fairly open, which allows of good spacing of the bolls. Bolls are large, 60 to 65 to the pound, with a preponderance of five-locks which open well and are moderately stormproof. The fibres, which are of medium to full body, have a staple length of 1 inch and are very strong. The colour of the fibre is white. The lint percentage ranges from 34 to 37.

Since its introduction to Queensland, considerable improvement in Miller has been effected, particularly in one selected strain, Miller (MIB.43.9.0), in which the lint percentage has been increased to approximately 37 per cent. as compared with 34 per cent. when the variety was introduced. In addition this strain is earlier maturing than the original stock and is more open in plant structure.

The Miller variety has always shown partial resistance to jassid, a leaf sucking insect which can cause serious loss of crop. A breeding programme to evolve jassid resistant strains of this variety has been carried out at Biloela Regional Experiment Station. Miller 41J was produced entirely by selection and is fairly resistant, but some recently evolved backcross Millers have proved to be entirely resistant, with all the good characteristics of Miller retained. Some of these are now available for distribution. The variety is recommended for the following soil types in the districts indicated hereunder.

Northern Darling Downs and Maranoa.—The loamy soils of the rising lands and foothills of the Main Dividing Range, originally timbered mostly with open box forests; the more fertile clay loams of the belah flats; some portions of the fertile red loams originally under either open forest or scrub, where moisture retention is better than average for this soil type.

Southern District.—The loams and clay loams of the slopes originally under scrub or open forest; the less fertile alluvial clay loams.

South Burnett.—The black and the brown loams and clay loams of the lower slopes originally under silverleaf ironbark forests; the less fertile grey loams and clay loams of the lower slopes originally under large box trees; the fertile brown and red-brown loams and clay loams of the scrubs.

Central and Coastal Burnett.—The more fertile soils of the gentle open forest slopes, the clay loam alluvials and the decomposed granite soils in the Mount Perry-Boolboonda area.

Plate 114.

Typical Silverleaf Ironbark Country, Callide Valley, Which is Suitable for the Miller Variety.

Plate 115.

Bluegum Alluvial Flats in the Callide Valley, Which are Suitable for the Miller and New Mexico Acala Varieties.

Upper Burnett.—The soils of the slopes originally under box or ironbark forests; the loams and clay loams of the scrubs.

Central District.—The soils of alluvial flats and slopes originally timbered with open forest (the very fertile deep loams or sandy loams adjacent to creeks should be avoided); the loams and clay loams of the softwood and brigalow scrubs.

Plate 116.

Softwood Scrub Land in the Callide Valley, Which is Suitable for the Miller Variety.

New Mexico Acala.

This strain of Acala was introduced to Queensland in 1934 from the Field Station of the United States Department of Agriculture at State College, New Mexico. Commencing from the first year of testing, the variety has been remarkable for its uniformity of plant and fibre characters and the high standard which it has maintained under Queensland conditions. In fibre characters it is one of the outstanding varieties grown in Queensland, such characters as drag, body, lint percentage and lint index all being of a very high standard.

The plant is of medium height with a strong erect main stem. Basal vegetative branches usually vary from one to three, one usually being considerably more vigorous than the others. Fruiting branches are long at the base of the plant but become shorter towards the apex of the plant. Leaves are medium-large in size and dark green in colour, the lobes being mostly long and pointed. Bolls are medium-large size, ovoid to ovoid-oblong in shape, with a slightly blunt point, and weigh from 50 to 60 to the pound. The bracts are rather small for an American upland type. The bolls are often pendant, open wide and have good stormproof qualities. Lint has an average length of $1\frac{1}{16}$ inch, with excellent drag and good strength, and is usually heavy bodied and clear white in colour. The lint percentage averages 37.

The symmetrical shape of the plant, the type of boll and the quality of the lint distinguish New Mexico Acala from all other varieties grown in Queensland. It matures earlier than other big bolled cottons and has the capacity to mature much of its crop at the same period. The variety, however, is extremely susceptible to attacks from jassids, which limits its sphere of usefulness in areas where this pest occurs. It does not appear to have the drought resistance of Miller or Lone-star but is very suited to irrigation. Work on the production of a jassid resistant back-cross New Mexico Acala hybrid is in hand at present.

The variety is recommended for the following soil types in the districts indicated hereunder.

Northern Darling Downs and Maranoa.—The better types of the dark brown clay loams of the open forest areas; the alluvial clay loams where irrigation facilities are available.

Southern District.—Results obtained so far in trials indicate that the variety has only limited possibilities in this district.

South Burnett.—The dark-brown clay loams of the lower slopes originally timbered with silverleaf ironbark; the less fertile heavy clay loams of lower slopes and alluvials originally under box trees, more particularly in the first three seasons after the breaking up of grassland.

Central and Coastal Burnett.—Not recommended for these districts.

Upper Burnett.—The loams and clay loams of the alluvials in the southern section of the district. It is not recommended for the northern half of the area, where the soils are too fertile and jassid attacks are frequently experienced.

Central District.—The fertile loams and sandy alluvial loams of the open forests adjacent to creeks in all but the coastal section of this district. The variety appears to be particularly suitable for growing with supplementary irrigation.

Lonestar.

This variety was introduced in 1923, but for a number of years it showed little evidence of being suitable for conditions in Queensland and it was not until 1930, when tested at Mundubbera on an ironbark slope with interspersed patches of brigalow, that the variety showed promise. Suitable strains were then developed in the Central Burnett, where the variety became very popular. In recent years, however, the variety has been less favoured and has been superseded to a great extent by Miller.

The introduced strain of Lonestar was vigorous in its habit of growth, usually with four strong basal vegetative branches, and the foliage was very coarse. Repeated selection has resulted in the development of a different type of plant, as the following description of a typical Lonestar plant shows:—

Plant growth is vigorous and of medium height, with two to four basal vegetative branches, two of which are usually large but fruit well. The internodal distance between the joints on the main stem is somewhat short. The fruiting branches are numerous, with a well-defined alternation of the internodes giving the branch a zig-zag type of growth. The lower fruiting branches are horizontal but the upper ones, which are normally shorter, are slightly angled from the horizontal, giving the plant an open habit which allows of good ventilation and sunlight penetration. Foliage is medium to large and very dark-green in colour. The bolls are well spaced on the fruiting branches and are large to very large with five-locks predominating. In shape they are broadly ovoid, with short, blunt points. They usually open well, are decidedly stormproof, and have a staple length of approximately 1 inch.

Strains of Lonestar are being grown successfully under a wide range of soil and climatic conditions, which may be summarised for the districts south of Mackay as follows:—

Northern Darling Downs and Maranoa.—The loams, clay loams and clay soils of the plains originally under open box forests; clay loams of the rising lands and foothills of the Dividing Range, which originally carried box trees as the predominating timber; decomposed sandstone areas originally timbered with cypress pine, bull-oak, spotted gum, and ironbark; the heavier types of the clay loam soils of the brigalow scrubs; the clay loams of the flats, originally covered with belah; the red loams and clay loams originally covered with a range of flora varying from open forest to scrub; alluvial clay loams on creek flats and in the folds and valley of the Main Dividing Range.

Southern District.—The brown to black clay loams of the open box forests; the brown to red-brown clay loams of the open forest slopes originally timbered mainly with both broadleaf and narrowleaf ironbark.

South Burnett.—The brown and red-brown clay loams originally timbered with broadleaf and narrowleaf ironbark, and the open gum-top box forests.

Central Burnett.—The brown and red-brown clay loams, as in the South Burnett; the grey and grey-brown clay loams originally timbered with open box forests; the loams overlying a clay subsoil, such as occur, for example, in the open forests chiefly carrying Moreton Bay ash and box; the brown and grey-black heavy clay loams of the brigalow scrubs.

Triumph.

This variety, which was originally known as Oklahoma Triumph in the United States of America, was introduced from that country in 1933. When first planted in Queensland the seed was clearly impure, as a wide range of plant types was observed. Fortunately, the variety responded well to individual plant selection and in a few years improved strains were released for commercial distribution. Continued work in this variety has produced strains which, because of earliness and high yielding ability, are suitable for the more fertile alluvial soils.

The following is an average description of the main Triumph strains now being grown:—

The main stem is erect and of medium height but inclined to bend over when bearing a heavy top crop. There are generally one to three vegetative branches, but usually they do not develop vigorously. The fruiting branches are numerous, horizontal, and long on the lower part of the main stem but shorten slightly higher up. The foliage is of medium size and dark green. Bolls are of medium size and occur roughly in equal proportions of five- and four-locks. Storm resistance of the open bolls is not good. The fibres average $\frac{15}{16}$ inch in length, are of medium body, fairly good strength and of medium drag, while the percentage of lint ranges from 35 to 36·5.

In a season when the planting rains do not occur until it is too late to plant the big bolled, later maturing varieties, Triumph can be planted as late as December on all soils that are moderately fertile with good chances of obtaining a profitable yield. Triumph is also the only reliable variety of cotton to plant on the most fertile alluvial loams in

the wetter districts. It has been demonstrated that in areas which are regularly subject to jassid attack, early plantings of this variety can produce a satisfactory crop before the jassid population is sufficiently large to affect the growth of the plants. Another important characteristic of Triumph is its ability to recover from a setback, caused either by insect activity or adverse climatic conditions, and form a good crop.

Triumph can be grown over a wide range of soils and climatic conditions. In fact, it is grown regularly in all the cotton districts except the main sections of the Central District. The following soil types are recommended for the variety in the main cotton-growing districts south of Mackay.

Northern Darling Downs and the Maranoa.—The heavy black clays and clay loams of the plains. Early autumn ploughing is especially advisable for these soils so as to build up subsoil moisture. It is also necessary to cultivate frequently to minimise the moisture loss caused by severe cracking which may occur on these soils. The fertile loams and clay loams of the softwood scrubs are suitable as well as the fertile loams of the alluvial areas along the main creeks and in the folds and valleys of the Main Dividing Range.

Southern District.—The fertile loams of the alluvials of the main valleys—especially if irrigation facilities are available; the fertile loams and clay loams of the lower levels of either open forest or scrub soils in the narrow side valleys entering the main valleys; the more fertile of the loams of the softwood scrubs.

South Burnett.—The more fertile loams and clay loams of the alluvials—especially if irrigation facilities are available; the fertile loams and clay loams of the softwood scrubs.

Central Burnett.—The fertile loams of the alluvials, especially if irrigation facilities are available; the fertile loams and clay loams of the softwood scrubs; the fertile loams and clay loams of both the open forests and scrubs on the slopes in the Dallarnil and Biggenden districts.

Coastal Burnett.—The fertile alluvial loams of the coastal plain; the more fertile loams of the scrubs and open forests on both the slopes and the alluvials in the inland sections of the district.

Upper Burnett.—On soils similar to those recommended for the South Burnett and the variety is recommended especially for fertile alluvials where irrigation facilities are available.

Central District.—Not recommended for this area.

Other Varieties being Tested in Queensland.

In addition to the main commercial varieties which have been described, the Department of Agriculture and Stock has under investigation a number of other varieties which have been imported more recently. Amongst these are several that have been imported for their potential suitability for machine harvesting. Newer varieties which show superiority in the district tests will be multiplied to provide limited tests on a commercial basis. If the general results obtained in these large scale trials indicate that one or more of the newer varieties are superior to the varieties now commonly grown, seed stocks will be increased as rapidly as possible for general distribution to cotton growers.

The Papaw.

G. W. J. AGNEW, Senior Experimentalist, Horticulture Branch.

THE papaw (*Carica papaya*) is a small herbaceous tree which is grown commercially in Queensland for its fruit. The tree is believed to be indigenous to Central America; it reaches a height of 15 to 20 feet and bears a crown of large, light-green, palmate leaves. The plant grows particularly well in the wet tropics of Queensland, where high temperatures and rainfall permit more or less continuous growth during most of the year.

Plate 117.

Papaw Plantation in Southern Queensland. Older plants are 15 months old and bearing fruit. Young plants in the foreground.

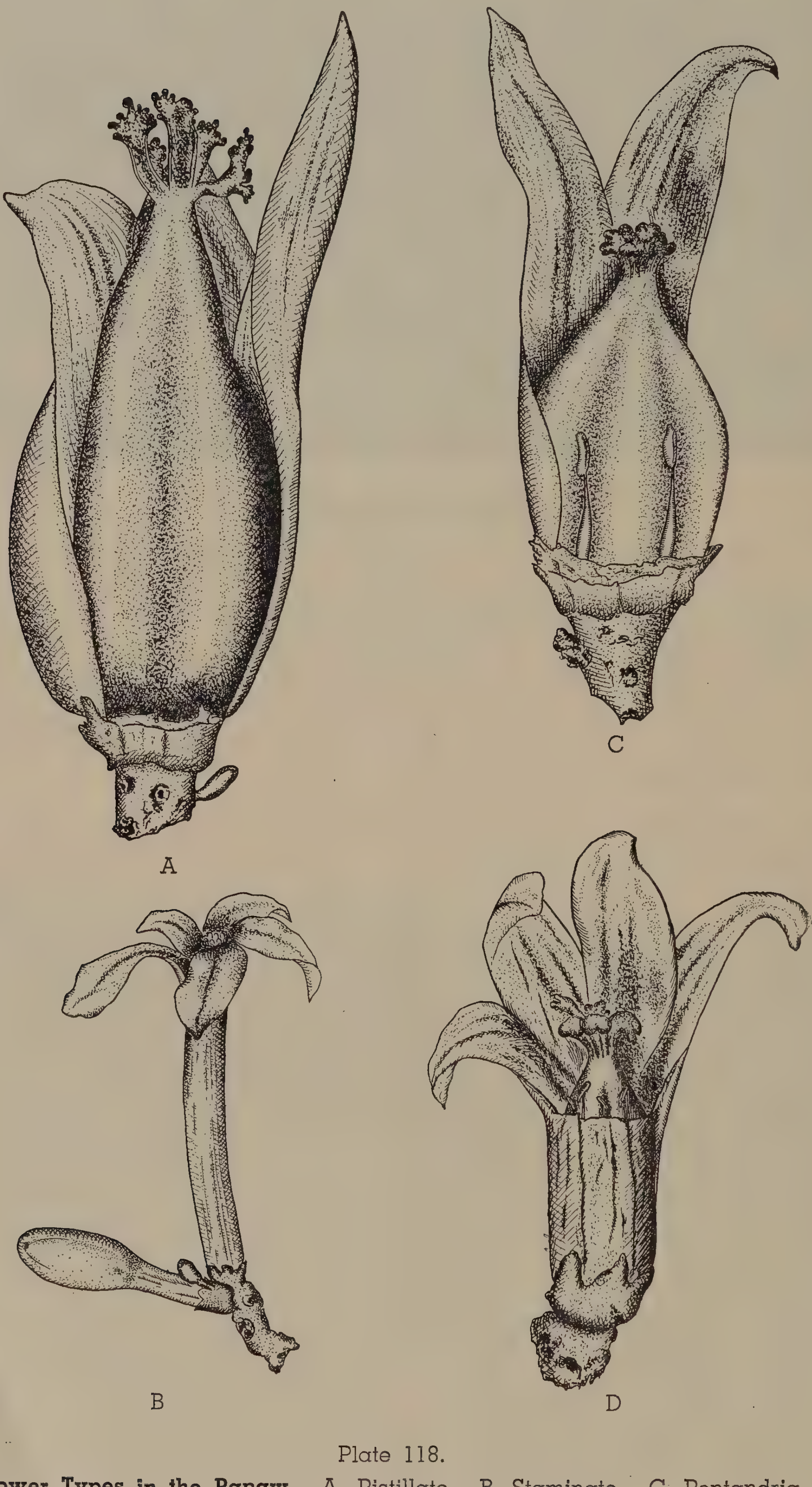


Plate 118.

Flower Types in the Papaw. A, Pistillate. B, Staminate. C, Pentandria. D, Elongata.

Optimum conditions for the papaw are not encountered in southern Queensland, where winter temperatures from June to September are often sufficiently low to affect adversely the development of the plant or the maturation of the fruit. Occasional severe frosts cause widespread damage among papaw plantations in low situations. In North Queensland, plantations are not subject to frost but cyclonic winds occasionally destroy crops in exposed parts of the tropical coast.

In spite of these hazards, many excellent plantations are to be found along almost the whole Queensland coast. The main centres of production are Redlands, Sunnybank, Brookfield and Aspley in the Metropolitan district, the Mary Valley and Gunalda in the North Coast district, Yarwun and Mackay in the Central district and Cairns in North Queensland.

FLOWER TYPES.

In the papaw plant there are three primary flower types—namely, pistillate, staminate and hermaphrodite. Individual trees may bear one, two, or very rarely, all three of these, but generally where more than one flower type occurs in a single plant, their co-existence is for brief periods only.

The five petals of the white pistillate or female flower (Plate 118A) are free for their entire length and surround the flask-shaped pistil in the centre. The stigma opens its five crinkled lobes at full bloom as receptive surfaces for pollen. The lower bulbous part of the pistil is the ovary in which the seeds develop.

In staminate or male flowers (Plate 118B), the comparatively small petals are fused together for slightly over half their length and form a slender tube which bears 10 stamens. Each of these has a yellow lobed anther from which pollen is liberated just prior to the opening of the flower. Staminate flowers cannot produce fruit.

Hermaphrodite flowers of the papaw are classified into three forms—pentandria, intermediate and elongata—according to the nature of their structural modifications. The *pentandria* form (Plate 118C) is somewhat similar to the pistillate flower except that a large stamen occurs near the base of each petal and lies along a groove on the outer surface of the ovary. Pentandria flowers produce a typically squat fruit with deep grooves and well-defined basal petal scars. The *intermediate* form comprises an indefinite group of freakish and distorted flowers in which stamens and the pistil occur in grotesque associations. Fruits produced by intermediate flowers are extremely irregular in structure and of little commercial value. The *elongata* (Plate 118D) is the commonest hermaphrodite flower. It has an elongate pistil partly enveloped by the petals which form a collar around the ovary. Elongata flowers give rise to long fruits with a small seed cavity often characterised by deep fissures.

TREE TYPES.

When pistillate and staminate flowers are borne on different plants, the species is said to be dioecious (Plate 119). Colloquially, trees bearing pistillate flowers are termed "females" while those which normally bear staminate flowers are referred to as "males."

The flowers of a female papaw tree are produced in the leaf axils on single or but simply-branched stalks varying from one to several inches in length, according to the characteristics of the strain. The

Plate 119.

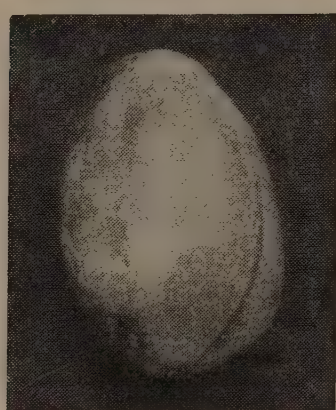
Tree Types in the Papaw. Female to left and male to right in a dioecious variety. Note the pendulous hermaphrodite fruit on the male tree.

principal flower is borne at the apex of the flower stalk and small subsidiary flowers are situated nearer the base. The size and number of the subsidiary flowers vary considerably on the one tree during the flowering season as well as between trees of dissimilar strains. Fruits produced by the pistillate flowers (Plate 120A) of female trees are usually rounded or oval in general outline, but common irregularities occur in the form of beaked fruits or fruits which taper at the stalk end.

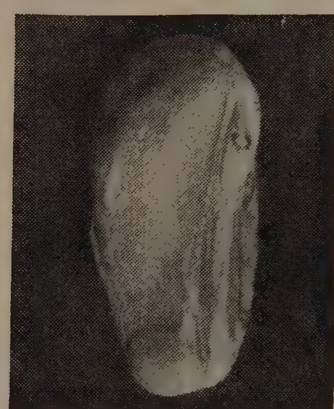
The flowers of a male tree are produced in large numbers on profusely branched stalks, which attain a length of from three to five feet. Some male trees bear a number of reduced hermaphrodite flowers at the terminals of these stalks, particularly during the cool spring and autumn months. These hermaphrodite flowers may produce fruit which is extremely variable in quality (Plate 120 B, C and D) and is often of little market value.

A

B



C



D

Plate 120.

Fruit Types in the Papaw. Derived from—A, pistillate flower; B, pentandria flower; C, elongata flower; and D, intermediate flower.

In hermaphrodite trees, the flowers are normal, with both stamens and pistil. They are produced on short stalks in the axils of the leaves and the subsidiary flowers near the base of the stalk are in many instances either functionally staminate or abnormal hermaphrodites. During the cool months, staminate flowers may be almost exclusively produced, and the tree then becomes virtually a male tree for a limited period. *Pentandria, elongata* and *intermediate* flower forms frequently occur on the same hermaphrodite tree, with the first two predominating from time to time during the flowering season. In some trees, however, one of these, usually *elongata,* predominates throughout the life of the plant. In Queensland, trees which bear practically all *elongata* flowers characteristically produce long, narrow fruit popularly called "Long Toms." At one time the term may have signified a distinct strain but at present it is applied indiscriminately to any long-fruited type of hermaphrodite papaw.

INHERITANCE OF SEX.

Queensland papaw plantations chiefly consist of trees in the dioecious group interspersed with a few hermaphrodites. The distribution of sex types in the progenies of the different possible matings is, therefore, of economic interest.

The segregations for the several possible crosses are:—

Parentage.	*Progeny Ratios.*	
Female x Male	Females and Males	1 : 1
Female x Hermaphrodite	Females and Hermaphrodites	1 : 1
Hermaphrodite x Male	Females, Males and Hermaphrodites	1 : 1 : 1
Hermaphrodite x Hermaphrodite	Females and Hermaphrodites	1 : 2

The progeny of the female-hermaphrodite cross will all bear fruit though different shaped fruits will be produced. Observations in plantations with female and hermaphrodite trees indicate that no male trees are needed for pollination if about two-thirds of the stand are hermaphrodites.

SEED-BEDS.

The usual procedure is to raise papaw plants in seed boxes filled with a free, sandy loam. The seed may be sown in drills about two inches apart at a depth of half an inch. When the young seedlings are about two inches high, they are pricked out and transferred to large seed-beds with a four-inch spacing between plants. Alternatively, the seed is broadcast over large seed-beds and raked out to give an approximate spacing of about three inches. The seed-bed is then covered with about half an inch of sandy soil and pressed or rolled. A third method is to plant the seed in individual containers, three seeds to the container, the containers being placed in the seed-bed area where they receive the necessary care and attention. Liberal waterings are necessary to ensure a good germination and the seed-beds or boxes should be protected from the sun by a partial shade such as forest oak or pine tree branches. Heavy shading is unnecessary and the cover should be reduced in overcast weather, otherwise the young seedlings may become spindly.

Planting the seed direct in the field is sometimes practised and has the advantage that plant development is continuous and the risks associated with transplanting are reduced. However, a great deal of care and attention is necessary in watering, weeding and protecting the plants from pests, particularly cutworms, until they are well established, and success is contingent on favourable weather conditions.

Germination under summer conditions should occur in from 14 to 20 days.

The quantity of seed sown depends on the spacing distance in the proposed planting. If an 8 feet x 8 feet spacing is adopted and the trees are planted on the standard square, there will be 680 trees to the acre. Four seedlings are required for each tree position to allow for the culling out of surplus male trees. Seed weights vary considerably with the variety but a seed-bed sowing of four ounces of air-dried seed will usually provide sufficient plants for a one-acre plantation. Such a sowing gives an adequate margin for seed-bed and transplanting losses resulting from unsuitable weather or other causes. A heavier seed rate per acre is necessary when field sowing is practised, for 10 or more seeds are placed in each tree position.

Papaw seed may be sown at any time during the summer. Plants from early summer sowings grow vigorously in the juvenile stage of development and the fruits borne in the following summer are set high on the stem. Autumn planting in the field following seed sowing in December is, however, the best practice in southern Queensland, for the weather is usually favourable for transplanting from late February to early April and the plants attain a height of about two feet or so before cold weather retards growth. The first crop of fruit is then set relatively low on the stem and this makes harvesting simpler.

TRANSPLANTING.

Prior to transplanting, the seed-beds are heavily watered. Seedlings are ready for transplanting when from four to six inches in height but only as many should be lifted as can be planted conveniently before wilting occurs. The importance of having the seed-beds close to the plantation site is, therefore, evident. The danger of losses at transplanting is less if the seedlings are grown in individual containers, for the root system is virtually undamaged when the plants are set out.

Seedlings should be planted with a trowel at the same depth as they were growing in the seed-bed and the roots should be well spaced before the soil is finally pressed into position. It is also advisable to trim the leaves when transplanting. If two or three showery, cloudy days follow transplanting, shading in the field should not be necessary. Potted seedlings also do not need shading. Seed-bed lifted plants require shading on the northern side, either with a small four-inch board pushed in the soil at the side and leaning towards the plant or with small leafy tree branches. Four seedlings are usually planted at each "hill."

FIELD POSITIONS.

The typical site for a papaw plantation is on sloping ground, and provision must be made for any necessary surface drains. The tree positions are then pegged out. Each tree position is forked or mattocked about four weeks prior to planting. If available, compost should be dug into each "hill," and in the less fertile soils, it is advantageous to add four ounces of a complete fertilizer high in phosphoric acid at the same time. Two weeks after planting out, a 2 oz. dressing of sulphate of ammonia per hill will promote vigorous growth.

Spacing distances for papaw plants (Plate 121) in the field range from 6 x 6 feet to 12 x 12 feet. Trees on virgin rain forest land grow very tall if they are planted close and much of the crop must be harvested by ladder (Plate 122). A spacing of 8 x 12 feet or 10 x 10 feet is satisfactory in these circumstances. An 8 x 8 feet spacing is, however, preferred under average plantation conditions.

SOIL AND FERTILIZER REQUIREMENTS.

In Queensland, papaw plantations are placed either on virgin land recently cleared of rain forest or hardwood forest, or on land which has grown pineapples, bananas or some other crop for several years. These soils vary considerably in both structure and fertility. Many plantations are necessarily placed on hillsides to avoid frost injury and are thus frequently associated with rocky and gravelly soils. Good drainage is essential, for waterlogging stunts the plant and is frequently associated with disease outbreaks.

Plate 121.

Young Papaw Plantation at Sunnybank. The plants will later be thinned to an 8-feet spacing in the row.

Plate 122.

Old Papaw Plantation. Note the great height and the small crown of leaves.

Where soil fertility is high, excellent yields of good quality fruit have been obtained without the use of fertilizers. Most typically, however, plantation sites occur on soils of low or medium fertility in which plant nutrients have been lost by continuous cropping, erosion and leaching. The papaw tree draws heavily on the available water and plant foods in the soil for at least eight months of the year and efficient plantation management is, therefore, essential.

Though much information remains to be obtained on fertilizer usage in papaw plantations, good results can be obtained on most soils from the use of an 8:10.5:5 or similar mixture applied at the following rates:—4 oz. for trees up to three months old; 12 oz. for trees up to six months old; 2 to 3 lb. for trees one year old and upwards. Three full applications should be made during the growing and blossoming period in September, November and February, with a light application in April.

Plate 123.

Papaw Stem Showing Constriction. This is the result of slow growth during the cold winter months or in a dry period.

PLANTATION MANAGEMENT.

Cultivation practices in papaw plantations vary considerably with the type of plantation. Many of these are so steep and rocky that anything other than hand cultivation is precluded. The plant spacing adopted will also influence the method of cultivation employed. Owing to the shallow rooting habit of the plant, only skim cultivation is permissible, but weeds must be suppressed, particularly during the dry spring and early summer months when stress conditions occur (Plate 123). Papaws respond well to heavy mulching with dry grass or other litter. The mulch cover retards surface evaporation, helps to suppress weed growth and provides a constant supply of decomposing organic matter.

Thinning.

The four plants in each tree position are retained until flowering takes place. They are then thinned out so that the final stand contains one male tree to every nine female trees. Instead of removing the surplus plants, it is good practice to lop off male trees one foot above ground level, and female trees two feet above the ground. Should the selected tree collapse a sucker from one of the lopped trees can then be trained to replace it. Should the selected tree make normal growth and bear a satisfactory plant crop, the adjacent lopped trees are then cut back to the ground.

Flower Production and Fruit Set.

During the principal flowering period from November to late January, each tree produces approximately four flowers per

week and the average setting is about 60 per cent. A much lower percentage setting can be expected from February to April, when protracted wet weather may prevent natural pollination.

The time taken for complete fruit development varies from four to nine months, the fruit from early summer flowers reaching maturity more quickly than that from late summer flowers. The early winter crop maturing in May and June is produced by flowers borne in November and December, whereas the spring crop in August and September is produced by late summer flowers.

Average tree production in a plant crop from the main flowering period (November to January) is about 30 fruits per tree with an average weight of approximately three pounds. A crop yield of this kind is equivalent to slightly more than three bushels per tree.

Branching.

Branching (Plate 124) commonly occurs in papaws as a result of injury to the growing tip. Some strains, however, branch more than others and will do so even in the absence of any injury. Most branched

Plate 124.

Branched Papaw Plant. Branching takes place when the primary growing point is injured.

trees produce smaller fruit than single stemmed trees, and except in very vigorous trees, branching is an undesirable character. High branches tend to collapse when they are carrying fruit and must be either propped or tied back to avoid this trouble.

Cutting Back.

Aged trees in a healthy condition can be rejuvenated by cutting them back to about two feet above the ground where the stems are solid. This can also be done with younger trees that have grown too tall for convenient harvesting. After cutting, buds develop from the stump and two or three of the most vigorous shoots are allowed to grow. Cutting should be done during the early spring and it is good practice to cover the cut surface of the stem with a tin to prevent cracking and subsequent decay.

HARVESTING.

In southern Queensland, fruit ripens throughout most of the year, but there are two important harvest periods—April to June and September to November. In northern Queensland the main harvesting periods are longer.

For local markets, fruit is harvested in the firm-ripe stage when the first colour is showing at the base, and the fruit becomes fully ripe in from four to five days. For export to southern States fruit should be picked at a stage which allows about eight days to the full ripe condition. The stage of maturity as gauged by external colouring of fruit will vary according to seasonal conditions, the variety grown and the requirements of the buyer, but generally the fruit should be harvested at an earlier stage in the summer than in the winter.

Great care must be exercised in harvesting papaws in the firm-ripe stage, as they bruise easily. The fruit should be cut and not pulled from the tree, as pulling often results in damage at the basal end. Fruit stalks should be cut close to the tree stem in order to prevent the immature fruit on the tree from rubbing on the protruding stub. The stalk on the fruit should be trimmed before packing.

The milky latex which exudes from the broken rind of immature papaws irritates the skin and an operator handling the fruit for a lengthy period should wear rubber gloves and an apron.

PAPAW VARIETIES.

Though many distinct papaw varieties, such as Cowleyii, Long Tom, New Guinea Red, Singapore Red and Solo, have been introduced into Queensland, nearly all commercial plantings are still grown from open pollinated seed and the identity of any variety has been lost. Two pure varieties recently released in Queensland are Bettina and Improved Petersen.

Bettina has been derived from an introduction from Florida (the ''Betty'') and a local selection. It is a vigorous, squat, umbrella-like tree, carrying smooth rounded-oval fruits of 3 to 5 lb. weight and with attractive external and internal colour. The flesh is comparatively thick (1 to 1½ inches), of firm consistency and attractive flavour, and is particularly suitable for canning.

Improved Petersen is derived from a reasonably pure strain grown in isolation for some years. It produces a tall tree which bears a single fruit in each leaf axil. The fruit has an attractive flavour and its

small size (2 to 3 lb.) is an asset on the fresh fruit market. In general, fruit quality is good but the skin colour could be better and its carrying qualities are scarcely adequate for distant markets.

FRUIT CHARACTERS.

The following features which influence fruit quality have been dominant in selection work in Queensland.

Size and Shape of Fruit: Smooth-surfaced, oval or rounded-oval fruits weighing 3 to 4 lb. are the most readily saleable either as fresh fruit or for canning.

Skin Colour: Differences in depth of colour are apparent in fruits of dissimilar varieties but a uniform rind colour is desirable. Partially seeded fruits colour more intensely at the apical end than the stalk end, which is often poorly seeded. Summer ripened fruits usually have a more even colour and fewer blemishes than those which mature in the cooler months.

Fruit Flavour: Flavour is a distinctive character which is difficult to specify, varies with the season at which the fruit matures and to most tastes is governed by the sweetness of the flesh. Broadly there appear to be two distinct flavours, the musk and the nasturtium or cress flavours, and the former is preferred by Queensland consumers.

Flesh Quality: Flesh thickness, which is of particular importance to the canning industry, varies considerably with the variety and the amount of seed in each fruit. A firm but not hard flesh is desirable for both the fresh fruit and canning trades. Fruit which lacks firmness of flesh at maturity usually carries badly.

HAND POLLINATION.

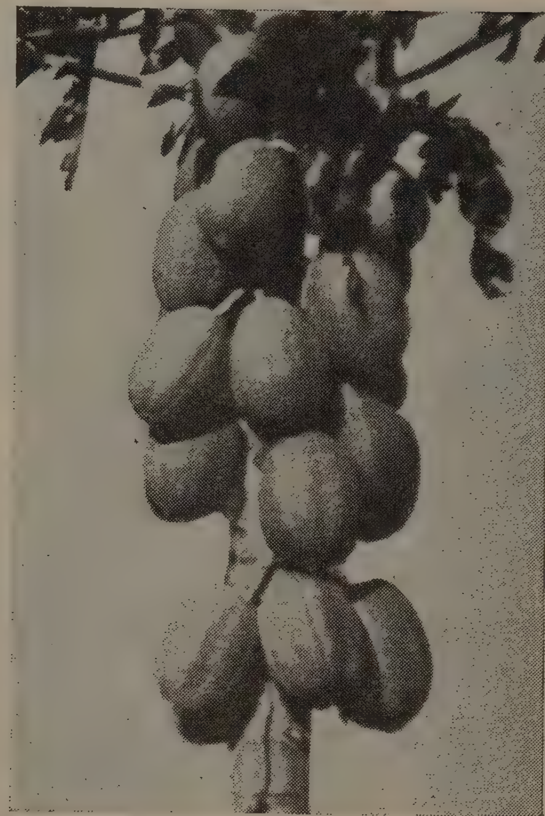
The operation of hand pollination in the dioecious group of papaws can be used to maintain an elite line of papaws or, if natural pollination is insufficiently effective, to produce a commercial crop of fully developed and well-seeded fruits.

To Improve Fruit Setting.

In central and southern Queensland, the effects of defective pollination are commonly seen in trees with an irregular setting of fruit or carrying undersized, seedless, misshapen fruits (Plates 125 and 126). These are the results of unfavourable climatic conditions, such as prolonged wet weather, for pollination during the flowering period from November to May.

Male trees shed their pollen during the late bud stage before the petals open. For hand pollination, it is therefore necessary to test the late-stage buds for free pollen by folding back the petals and tapping the bud with the finger. The operator collects a sufficient number of suitable late-stage male flower buds to complete the pollinations in hand. Where male trees are plentiful, whole branches of flowers may be broken off and the buds plucked as required. The unfurled petals of the flower bud are broken off and the remaining portion is used as a brush to dust pollen lightly over the stigma lobes of the female flower. Within about three days the stigma lobes begin to wither and turn brown and further pollination is of no value.

A



B

C

Plate 125.

Papaw Pollination—A, Light crop of uneven shaped fruit in a plant which received insufficient pollen. B, An even crop in a plant subjected to good natural pollination. C, Large rounded fruit in hand pollinated papaws of the variety Bettina.

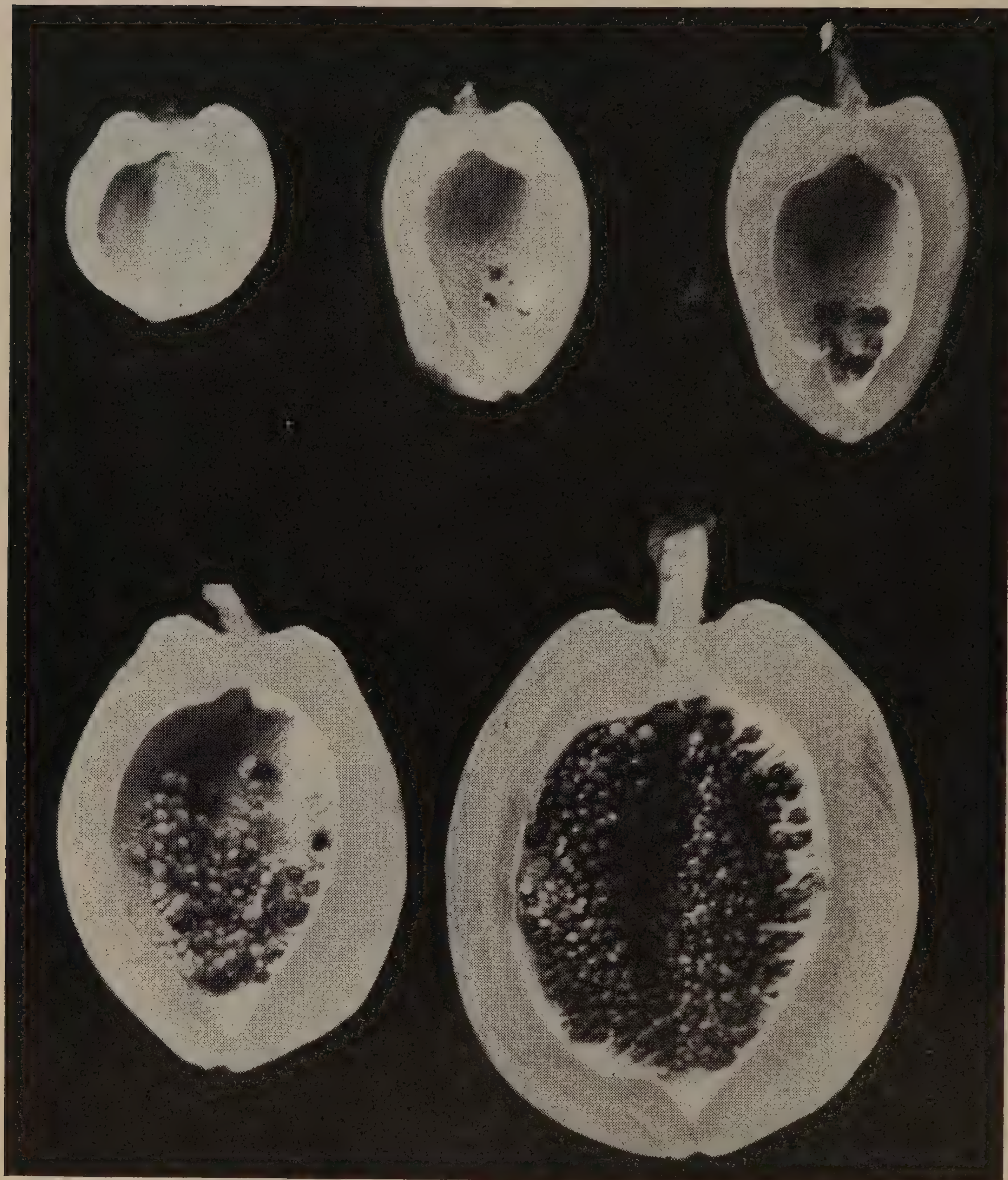


Plate 126.

Fruit Size and Pollination. The amount of seed indicates the degree of effective pollination and is correlated with both the size and shape of the fruit.

In commercial plantations, hand pollination in the first flowering season should be done at intervals of about three to four days. With semi-dwarf varieties the operation can be continued through the second flowering.

Controlled Hand Pollination.

In order to maintain a pure variety in the dioecious group of papaws, flower pollination must be carried out in selected female plants under controlled conditions. Flower buds of the female tree are, therefore, covered with 4 x 3 inch paper bags a day or two prior to their opening. All subsidiary flowers on the principal flower stalk are first removed, the bag being slipped over the large apical bud and clipped

tightly on to the flower stalk with a paper clip or fastener so as to exclude foreign pollen. When the flower opens, the bag is temporarily removed, pollen from late-stage buds of the selected male tree is dusted on to the stigma of the female flower, and the bag is again placed in position to cover the flower. The transfer of pollen is made as quickly as possible.

The pollinated flower is appropriately labelled, with the male and female parentage recorded on the label. Commercial cardboard tags dipped in hot paraffin wax after marking with waterproof ink have been found useful for this purpose. The loop of the tag is slipped over the pollinated flower and held on the flower stalk. Seven days after pollination, the paper bag is removed.

Each hand pollinated flower should produce a fruit with from 500 to 1,000 seeds. It is advisable to treat three or four times the number of flowers estimated to give sufficient seeds for current requirements after allowing for incidental losses.

Aiding the Pineapple Industry.

In a report on the operations of the Horticulture Branch of the Department of Agriculture and Stock during 1950-51, the Director of Horticulture (Dr. S. A. Trout) states that pineapple plant selection was the main theme of the Branch advisory campaign during the year, as elimination of inferior planting material is essential if the industry is to develop on sound lines.

On the pineapple investigational side, attention was given to weed control, fertilizer requirements, regulation of flowering and fruiting, and other aspects.

Firm recommendations for the use of sodium pentachlorphenate for the control of weeds were issued to growers, and attention is now being given to PCP-diesel oil emulsions, which are more suitable against summer weeds.

Fertilizer trials have been established on distinct soil types at Beerwah, Nambour, Flaxton and Dagun.

Hormone treatment of pineapple plants, which can be used for regulating flowering and ripening and increasing fruit size, is being further investigated in an endeavour to devise cheaper methods of application.

The transport of factory pineapples in crates containing 12 cases was shown to reduce handling costs without affecting factory yield.

Progress was made in investigations into the utilisation of cannery wastes.

TUBERCULOSIS-FREE CATTLE HERDS.
(AS AT 19th SEPTEMBER, 1951.)

Breed.	Owner's Name and Address of Stud.
Aberdeen Angus ..	The Scottish Australian Company Ltd., Texas Station, Texas F. H. Hutton, "Bingegang," Dingo
A.I.S.	F. B. Sullivan, "Fermanagh," Pittsworth D. Sullivan, "Bantry" Stud, Rossvale, *via* Pittsworth W. Henschell, "Yarranvale," Yarranlea Con. O'Sullivan, "Navillus Stud," Greenmount H. V. Littleton, "Wongalea Stud," Hillview, Crow's Nest J. Phillips and Sons, "Sunny View," Kingaroy Sullivan Bros., "Valera" Stud, Pittsworth Reushle Bros., "Reubydale" Stud, Ravensbourne H. F. Marquardt, "Chelmer," Wondai W. G. Marquardt, "Springlands," Wondai A. C. and C. R. Marquardt, "Cedar Valley," Wondai A. H. Sokoll, "Chelmsford," Wondai
Ayrshire	L. Holmes, "Benbecula," Yarranlea J. N. Scott, "Auchen Eden," Camp Mountain "St. Christopher's and Iona" Studs, Brookfield Road, Brisbane
Friesian	C. H. Naumann, "Yarrabine Stud," Yarraman J. F. Dudley, "Pasadena," Maleny
Guernsey	C. D. Holmes, "Springview," Yarraman
Jersey	W. E. O. Meier, "Kingsford Stud," Rosevale, *via* Rosewood J. S. McCarthy, "Glen Erin Jersey Stud," Greenmount J. F. Lau, "Rosallen Jersey Stud," Goombungee G. Harley, Hopewell, Childers Toowoomba Mental Hospital, Willowburn Farm Home for Boys, Westbrook F. J. Cox and Sons, "Rosel" Stud, Crawford, Kingaroy Line R. J. Browne, Hill 60, Yangan P. J. L. Bygrave, "The Craigan Farm," Aspley A. Verrall and Sons, "Coleburn Stud," Walloon R. J. Crawford, "Inverlaw Jersey Stud," Inverlaw, Kingaroy P. H. F. Gregory, "Carlton," Rosevale, via Rosewood E. A. Matthews, "Yarradale," Yarraman A. L. Semgreen, "Tecoma," Coolabunia G. & V. Beattie, "Beauvern," Antigua, Maryborough L. E. Meier, "Ardath" Stud, Boonah A. M. and L. J. Noone, "Winbirra" Stud, Mt. Esk Pocket, Esk

Plant Poisoning of Stock.

In a survey of losses from plant poisoning during the past year, the Director of Veterinary Services (Mr. C. R. Mulhearn) lists the following plants as incriminated or suspected:—Noogoora burr, poison peach, yellow daisy, lantana, bracken fern, yellow-wood, wild tobacco, caustic vine, green cestrum, wild cottons, native indigo, Crofton weed and Gomphrena weed.

PLANT PROTECTION

Potato Tuber Moth Control In South Queensland.

A. W. S. MAY, Entomologist, Science Branch.

THE potato tuber moth (*Gnorimoschema operculella* Zell.) is a serious pest of potatoes in Queensland. Though it is more usually considered a pest of the tubers both prior to harvest and in storage, larval damage in the tops interferes with normal plant development and can materially reduce yields. In the southern part of the State, this pest is more prevalent in the spring crop and the adoption of a regular schedule of control measures should be considered a necessary feature of potato production.

SEASONAL HISTORY.

Overwintering moths deposit eggs on the leaves soon after the plants appear above ground, and the resulting larvae skeletonise the leaf tissues or burrow into the growing point of the stem. Larval damage in the tops increases as new generations of the pest develop and often attains serious proportions in hot, dry seasons. Complete plant defoliation may then occur before tubers are formed.

As the crop approaches maturity the moths lay eggs on the tubers should these become exposed, or accessible through cracks in the soil. When the tops wilt or dry out the larvae will also migrate to unprotected tubers.

The insect may remain active in the field during summer in volunteer potato plants and in alternate hosts such as tobacco and some native related plants, and in stored tubers. Numbers wane, however, with the approach of cooler weather and this pest is rarely of major importance in autumn crops.

CONTROL MEASURES IN THE FIELD.

Every effort should be made to prevent the pest attaining populations that may cause irreparable damage to the plants. Cultural and chemical methods can be combined to achieve this end.

Pre-planting.

Farm hygiene, including the destruction of all residues from earlier potato crops, and other moth harbourage, should be given attention.

Pre-flowering.

Once the crop has germinated and until flowering commences, the plants should be given good conditions for development. Uninterrupted top growth during this period will ensure maximum tuber formation.

DDT, in either spray or dust form, should be applied to prevent larval damage to the tops and to check infestations of aphis, jassids, the 28-spotted ladybird and the other potato foliage pests.

Post-flowering.

Top protection is also essential during this period as it ensures tuber development.

Insecticidal application may not entirely prevent tuber attack as the crop approaches maturity; therefore, as an added precaution the plants should be hilled.

Early hilling can interfere with tuber formation, so this operation should commence after the majority of tubers are formed, but before they develop sufficiently to crack the soil. Hills should be maintained until harvest, particularly when the soil is prone to cracking.

Rate of DDT Application.

DDT, preferably in spray form, should be applied at the rate of one pound per acre at each application.

As many types of spray machinery are used by potato growers the method of achieving this rate of application can be calculated from the following. Two-fifths of a gallon of 25 per cent. DDT emulsion, half a gallon of 20 per cent. DDT emulsion, two pounds of 50 per cent. DDT dispersible powder and 50 pounds of 2 per cent. DDT dust, all contain one pound of DDT. Any one of these quantities may be used to obtain the required dosage per acre, the spray forms by diluting the particular quantity of concentrate with an amount of water equal to the output per acre of the spray machine.

Timing of DDT Applications.

DDT applications should commence soon after moths are first noticed in the field, and should be continued while moths are present.

Two treatments, and possibly a third, spaced 2 to 3 weeks apart will be sufficient to prevent damage in the tops, and to reduce the likelihood of a population developing before harvest.

Harvesting.

Harvesting should not be delayed after the tubers have reached maturity. If this is unavoidable during dry weather, hilling should be continued, or light spray irrigation used to prevent serious ground cracking.

As the tubers are bagged in the field they should be treated with a 2 per cent. DDT dust at the rate of half a pound per bag.

A convenient method of dusting the tubers is to place a small amount of dust in the bottom of the tin used for picking up each time before it is filled.

As larvae quickly migrate from the rapidly wilting tops and moths lay eggs on exposed tubers, the sequence of digging, dusting and bagging should be a quick and continuous operation.

CONTROL MEASURES IN STORAGE.

Stored potatoes, including seed set aside for the next crop, can be protected from tuber moth attack by thorough treatment with 2 per cent. DDT dust at the rate of half a pound per bag.

An alternative and equally effective method entails the storing of tubers in bags that have dried after being dipped in a 2 per cent. DDT emulsion.

To reduce the likelihood of rots developing during storage, only reasonably sound potatoes should be placed in the bags.

Surface Treatments Against Two Common Timber Borers.

A. R. BRIMBLECOMBE, Entomologist, Science Branch.

THE powder post beetle (*Lyctus brunneus* Steph.) and the Queensland pine beetle (*Calymmaderus incisus* Lea) are frequently responsible for serious damage to timbers in Queensland (Plates 127 and 128). The former attacks the sapwood of a variety of timbers while the latter attacks only certain pine timbers.

The treatments described below to deal with these borers are not approved preventive treatments satisfying the requirements of "The Timber User's Protection Act"* but are recommended for application in buildings, to furniture and other manufactured articles where infestations have occurred in non-immunised timbers and when thoroughly carried out should be effective in arresting attacks and preventing further infestations.

Materials.

A mixture of equal parts of K55 standard Creosote and kerosene is good for borer control generally, but it leaves an oily brown stain which is difficult to obliterate and subsequent painting is not practicable without the use of special priming coats. Where staining is of no consequence this mixture is recommended.

The following solutions are suitable if staining is to be avoided, and where it is desired to paint the treated surface. A month should elapse between the last application and painting.

Pentachlorphenol.

"Caltex Wood Preserving Oil."
"Vacuum Wood Preserving Oil."
"Pent-o-leen."

Zinc naphthenate.

"Hardiproof Clear."

Copper naphthenate.

"Hardiproof Green."
"Coponol."

Methods of Application.

On rough or unpainted surfaces applications may be made by brushing, spraying or injecting, but on painted or finished surfaces the injection method is most suitable.

Treatments for powder post beetle attacks need be applied to the sapwood only, if this can be readily distinguished. General applications are desirable for attacks by the Queensland pine beetle, particularly on the underside of floors.

Brushing:—The preservative solution should be brushed liberally on all accessible surfaces, at the rate of one gallon to 100 to 150 square feet where a large area is involved.

* This Act applies to the use of timbers susceptible to the powder post beetle.

Plate 127.

Queensland Pine Beetle Damage. Hoop pine timber showing internal damage and emergence holes.

Plate 128.

Powder Post Beetle Damage. Tulip oak timber showing internal damage and emergence holes.

Spraying:—As a substitute for the brush treatment a low pressure spray such as given by a stirrup pump or knapsack pump may be used. This method should be of advantage in difficult places on the underside of floors.

Injecting:—Preservative solution may be injected, by means of a syringe, into the emergence holes until the tunnelling is saturated. The holes should then be plugged with putty or plastic wood filler. This treatment is recommended primarily for the Queensland pine beetle and on unpainted surfaces it should be followed by a brush application.

Timing of Applications.

Against the Powder Post Beetle:—Four single applications at intervals of three months, one application being given particularly in late August.

Against the Queensland Pine Beetle:—Four single applications at yearly intervals, in late August.

CAUTION.

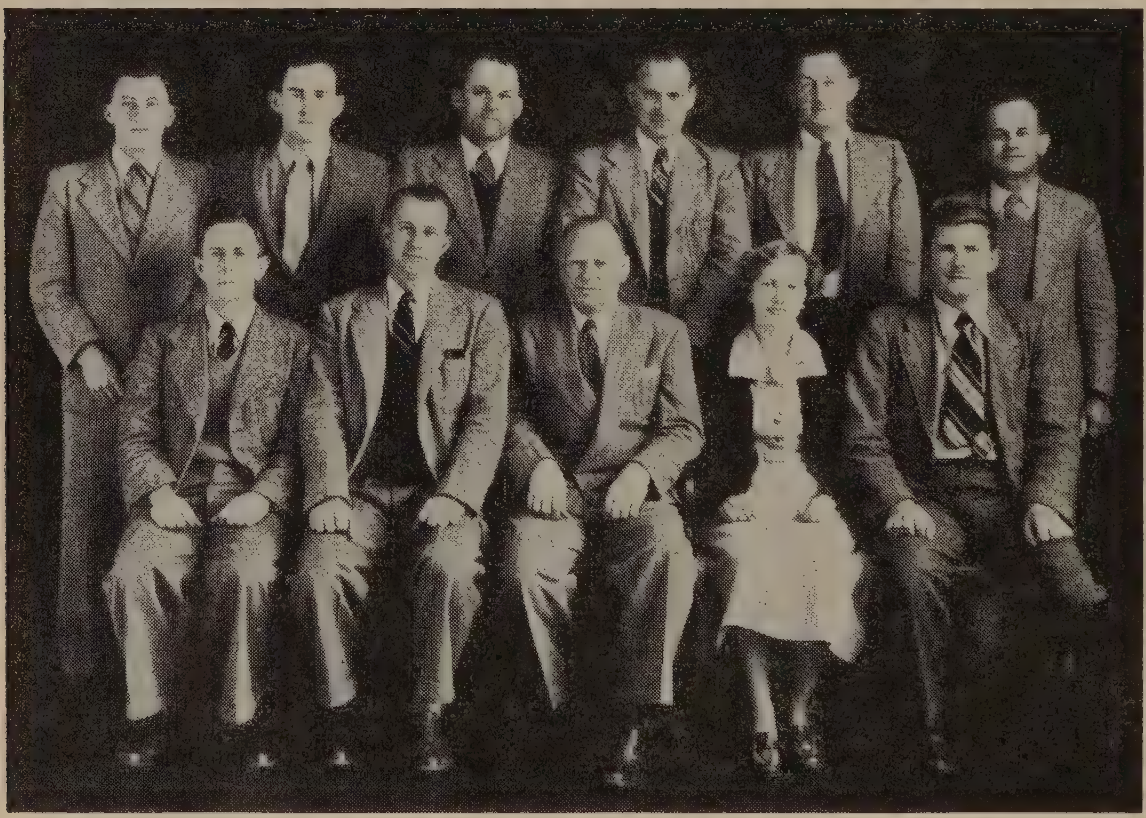
With each of the chemicals listed above there is a risk of skin irritation and operators are cautioned against splashing on tender parts of the body. When splashing is unavoidable suitable "barrier creams" should be used, "Innoxa Q.B.5" is particularly suitable when using pentachlorphenol. The use of goggles and a nose mask is recommended when spraying in cupboards and other difficult places where inhalation of fumes is likely. If the skin has been splashed soap and warm water should be used as soon as possible.

Pig Officers' School.

IN accordance with the Department's policy of providing refresher courses for field officers of various branches, members of the Pig Branch attended a school conducted by the Department in Brisbane during August.

The officers were given the latest information on selection of stock, breeding, feeding, housing, management, and disease control. Visits were paid to factories and institutions to secure additional information. An interchange of views and ideas between officers from various districts also proved beneficial.

Those participating in the school included the Officer-in-Charge of the Pig Branch (Mr. F. Bostock), Senior Adviser E. L. Melville, Advisers T. Abell, J. Christensen, C. R. Grieve, J. Liddell and C. Porter, Assistant Husbandry Officer K. Hutchinson, and Cadets J. Aitken and J. Hunter.



Front Row:—T. Abell, E. L. Melville, F. Bostock, Miss B. Barralet (Typist), K. Hutchinson.

Back Row:—J. Hunter, J. Aitken, C. R. Grieve, J. Liddell, C. Porter, J. Christensen.

An Elevated Milking Bails.

P. McCALLUM and O. H. HEINER, Division of Dairying.

THE principle of the elevated milking bails—that is, having the cows at a higher level than the milker to reduce stooping—is not new to Queensland. Several dairies in the State have had semi-elevated milking bails for over 20 years, but the idea went out of favour until the visit to Australia about two years ago of Professor Petersen of U.S.A., when interest was again aroused.

Though the idea is not new to Queensland, the Americans were the first to fully develop and carry it to its logical conclusion by raising the cow well up in the air so that the milker has no need to bend his back at all. The latest design of elevated milking shed in the United States has the floor on which the cow stands raised 30 inches above the floor of the milker's alley. This eliminates stooping of the operative during milking. Stooping was not entirely avoided during milking in the elevated bails known as echelon or race bails (Plate 129), which were at one time fairly popular in Queensland and New South Wales. In these bails the difference in the levels of the floors was about 12 to 15 inches.

In the latest American bails each cow stall, which is of all-metal construction, is made to completely enclose the cow (Plate 130). In the echelon bails which were popular here some years ago the cows mostly entered at ground level and the milker's alley was below ground level with steps down at each end. A serious disadvantage of this type was the lack of drainage from the milker's alley. Where this type of shed was built on sloping ground, the floor where the cows entered was built up a little, allowing this end of the centre alley to be at ground level with steps leading down from the separator room end. A further disadvantage of these sheds was the dust which was created by the cows coming out and around both sides of the separator room. The combined dairy building now usually built in Queensland provides for the cows to enter at the end farthest from the separator room, and leave the bails by means of a concrete race (four feet wide) which takes them to the end of the bails again and thus away from the separator room. This allows a 30 ft. stock-free area around the separator room and so reduces dust and contamination.

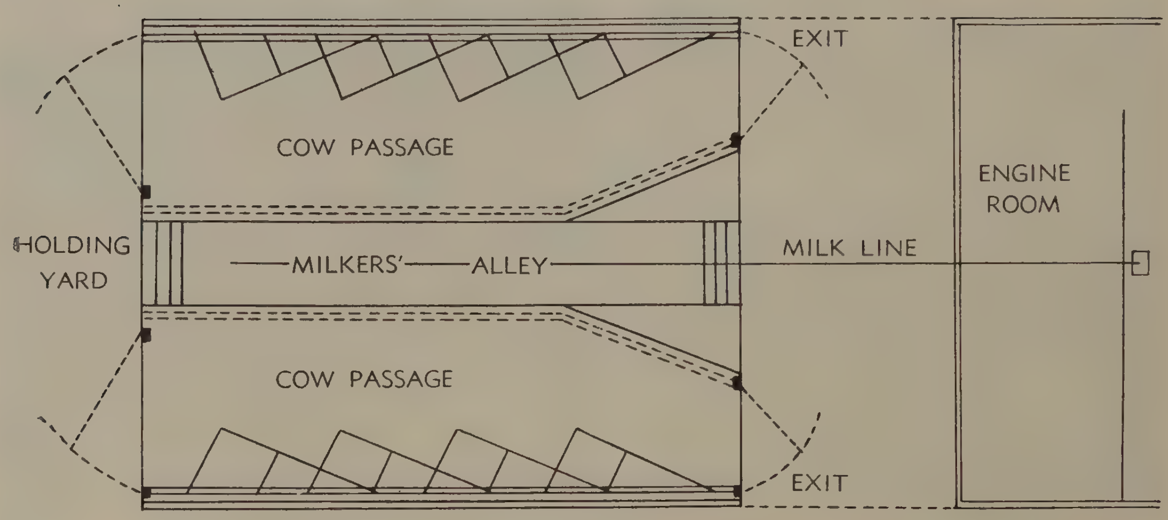


Plate 129.

Sketch of Layout of Echelon Type Elevated Bails Once Popular in Queensland.

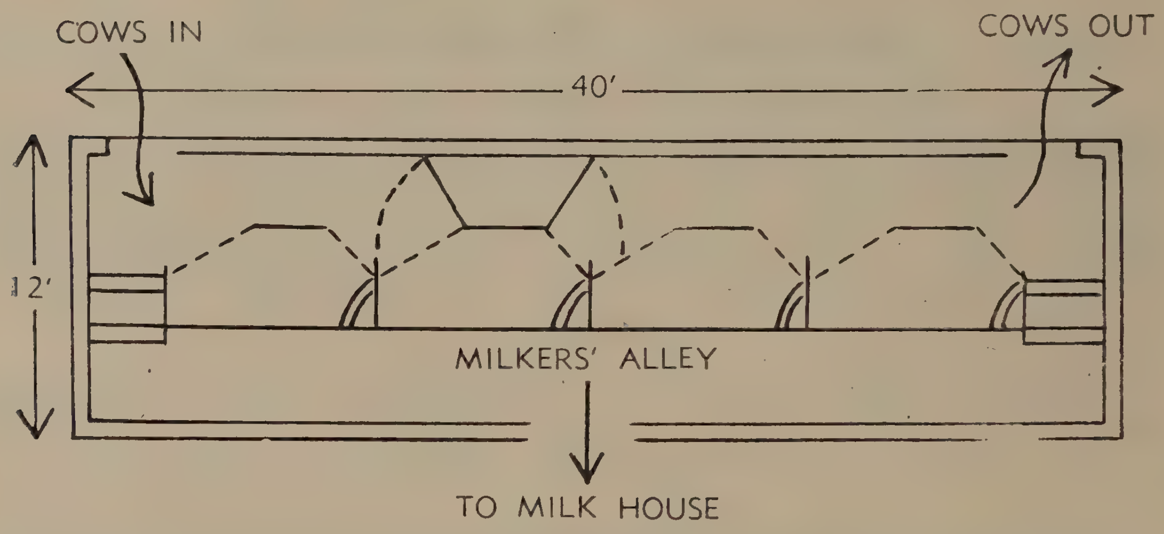


Plate 130.

Sketch of American-type Elevated Bails, in which the Cows are Completely Enclosed.

A New Zealand farmer who made a close study of the Petersen Elevated Milking Bails compromised by raising the cows 15 inches above the ground and having the centre alley or well 15 inches below the ground. The cows entered and left the milking race by long sloping ramps.

The American type elevated bails are not well adapted to Queensland conditions for several reasons. Firstly, it is unnecessary to keep cows indoors in Queensland. Secondly, in America, where the releaser type of milking machine is not used, the vacuum line for the bucket-type which is in general use runs at floor level along the edge of the elevated floor, and the milk is carried in the buckets to the milk room. Concentrates are fed to the cows while being milked.

Though there has been a good deal of interest shown in this State with regard to elevated bails, the main difficulty has been to determine a suitable adaptation to Queensland conditions. Through the ingenuity of Mr. J. J. Schabe, of Thangool, the first all-metal elevated milking bail in Queensland has been constructed (Plates 131 and 132).

Being an entirely new idea, many unthought of problems arose during the course of its construction, but all these were satisfactorily ironed out. With the view to helping other dairymen who may be interested in this new labour-saving shed, some of the details concerning its dimensions are outlined.

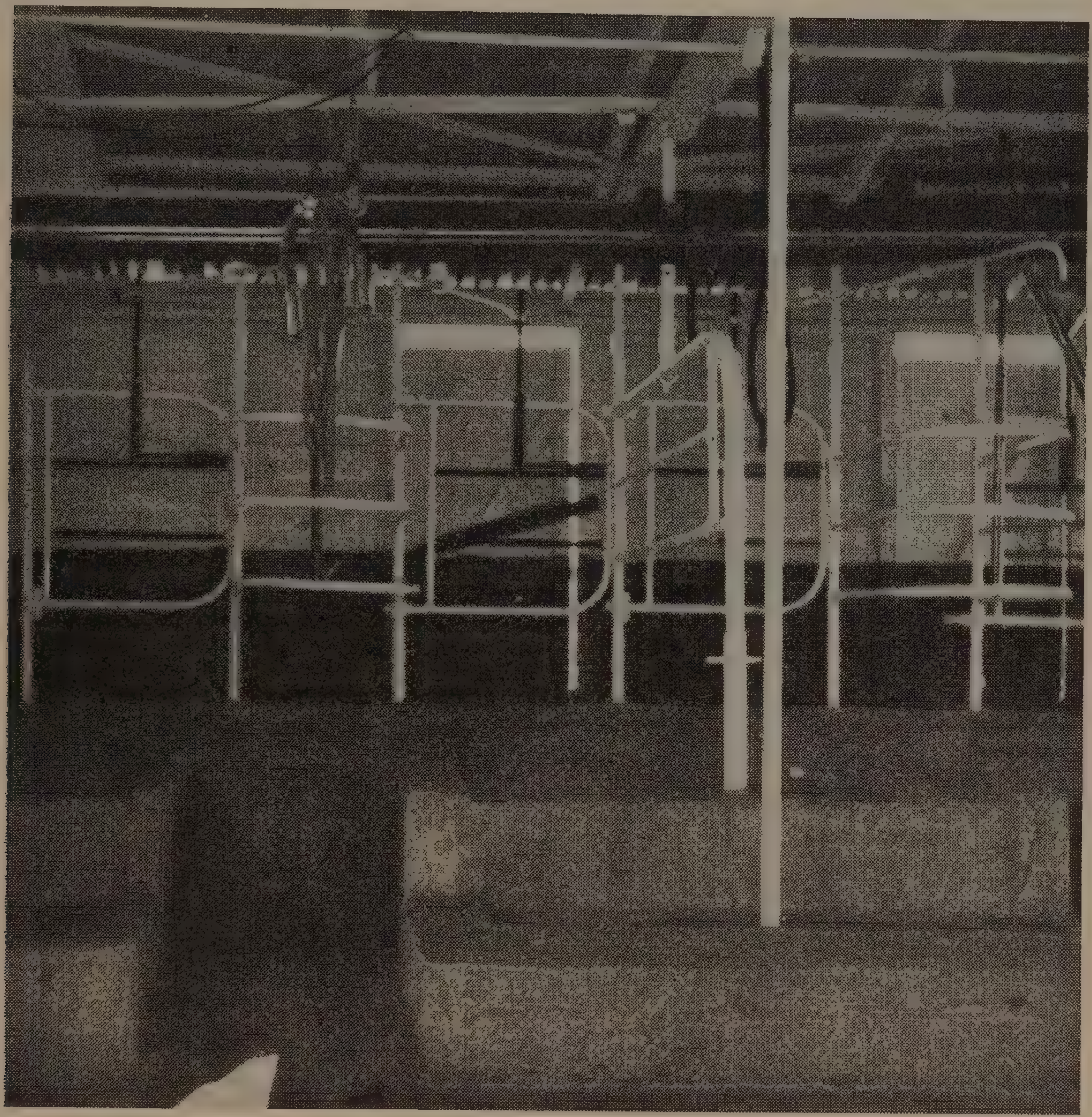


Plate 131.

General View of Elevated Bails Built by Mr. J. J. Schabe, of Thangool.

The layout and dimensions follow very closely those of the combined dairy building plan of the Division of Dairying of the Department of Agriculture and Stock. The dairy building, 41 feet long, is made up of a cream room 6 feet by 8 feet to house the dairy refrigerator, a separator room 8 feet by 8 feet, an engine room (or air space) 6 feet wide, and a 21 feet long three-unit milking shed of six bails with the all metal ''dummies'' suspended from the roof. The width of the shed is 18 feet. At the entrance to the shed is a small holding yard, 12 feet wide, covered by a lean-to roof.

The concrete foundations of the shed were laid before any timber work was done. A foundation sketch of the layout is shown in Plate 133. ''Dwarf'' concrete walls 18 inches high, above the finished floor level, keep all woodwork well above waterline, protect it from white ants, increase its life and make for easy cleaning and hosing down. The

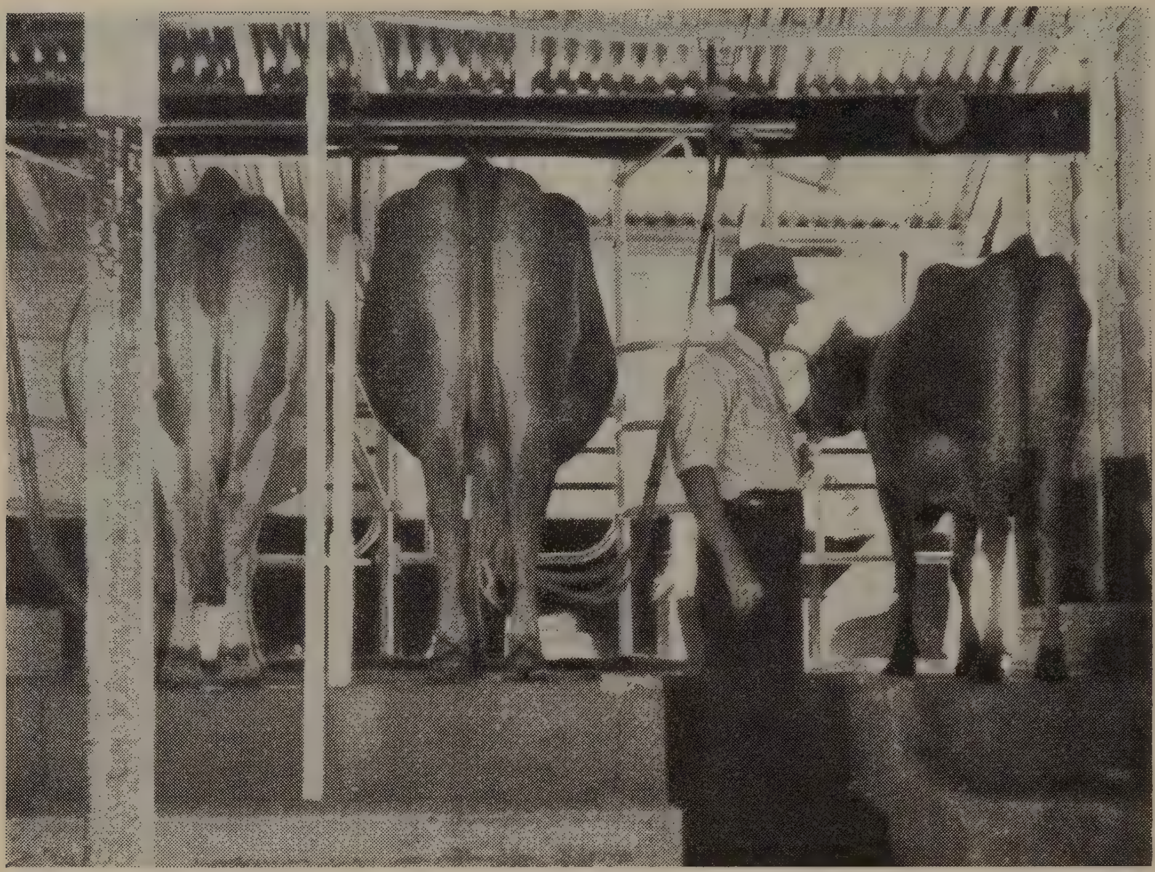


Plate 132.

View of Cows Being Milked in Elevated Bails.

dwarf walls could be advantageously increased up to a height of 3 feet on both ends of the milking bails—that is, between the engine room and first bail and the bail farthest from the separator room. Bolts set in the concrete when it is being laid allow all bottom plates to be firmly bolted to the concrete foundations. All drainage is effectively graded from the separator room end to the farthest bail. A heavy metal wash-up trough, a steam sterilizer and an hygienic metal draining rack are provided in the separator room section. A 3 feet 6 inch wide concrete race is provided in front of the bails. The cows pass into this race on leaving the bails and are thus taken to the end of the shed and away from the separator room. The roof of the shed is extended to cover the exit

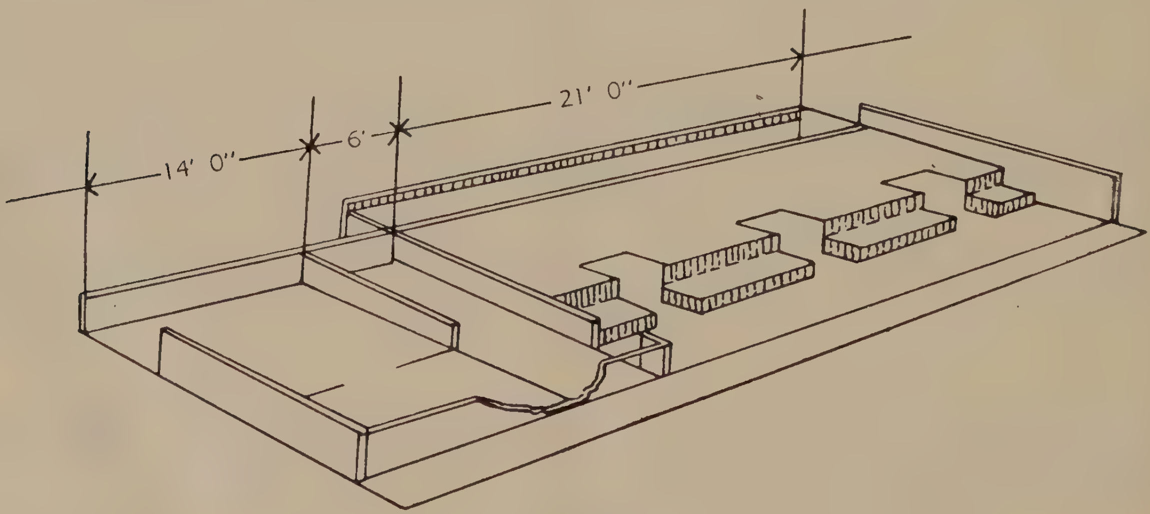


Plate 133.

Foundation Sketch of Dairy Shed with Three-unit Elevated Bails.

race, which is also walled in for protection from the weather. This exit race, together with the concrete entrance to the bails, practically eliminates the dust and mud menace. An added feature of Mr. Schabe's layout is a concrete foot-bath about 10 feet long and 3 feet wide which extends from the main cowyard to the small concrete holding yard. This foot-bath has proved a boon during the wet season, as practically no mud is carried into the bails.

The all-metal bails were designed for the cow's head to be held in a metal yoke during milking, but this tended to slow up milking operations and was eliminated. Metal dummy bails were not provided by the firm supplying the metal bails and had to be made on the job. One metal gate was provided in the centre of each bail unit and leading to the exit race, but this idea was also discarded in favour of a metal gate in front of each cow, allowing her to walk straight into the race. All metal gates open the one way, turning the cows down the race. The elevated bail does not lend itself to one gate in the centre of the unit, as cows are likely to slip down into the milker's alley. The metal "dummy" bails tend to keep the cow straight on the platform. Another advantage of the metal dummy is that it provides a convenient place on which to hang the teat-cup assembly, when necessary, between milking cows. However, these dummies should not be right back to the edge of the milker's alley, but sufficient space should be left to place a milking machine test bucket on the platform for the carrying out of herd recording.

A small dwarf wall an inch or two high is placed around the U of the milker's alley to prevent any water or urine running into this section. In the milker's alley a small recess six inches deep and six inches high is let into the wall of the cow platform at floor level to make room for the operator's feet and thus allow him to stand close to the cow. The small dwarf wall can be seen in Plate 132.

Mr. Schabe's elevated bail is only 20 inches high, whereas the American bail is 30 inches above the floor of the milker's alley. The height of 20 inches is suitable under Mr. Schabe's conditions, as he is small in stature and he finds it a suitable working height with his Guernsey herd. A tall person would require the elevated bail about six inches higher.

No difficulty is experienced in getting the cows to walk up the two 10-inch high concrete steps on to the ramp. So as to allay any fears in this regard it might be as well to mention that the first step was originally only 15 inches wide and the cows very often did not bother to step on this step but stepped up the 20 inches in one stride. To prevent this the first step has been widened to 30 inches so that the cows must take two steps to reach the platform.

Heifers take to the new idea equally as well as the older cows. Mr. Schabe usually puts his heifers through the bails for a week or so before they calve to accustom them to the surroundings, but on one occasion five heifers came into production without having been through the bails before and no trouble was experienced in breaking them into the elevated bail. Four of them walked straight up into the bail, while one had to be coaxed for a couple of milkings. It might be as well to mention that Mr. Schabe's Guernsey cows are all quiet and are treated with kindness so as to get the best out of them. His opinion of the elevated bail is that it makes quiet cows quieter.

It might also be thought that the milker is at a great disadvantage as far as manure splash is concerned, but this is not a problem in Mr. Schabe's case as his cows very seldom do any droppings in the bails and if they do it is caught on a shovel and put into the wheelbarrow. while any urine is caught in a tin. There was a lush growth of grass in the summer of 1950 which had a very laxative effect on the cows, but manure splash caused no discomfort.

With the cows so elevated it might be thought that the milk line and milk vat would be very high up in the air, but this is another thing which has worked out satisfactorily. The milk line in the bail farthest from the separator room is 5 feet 6 inches from the platform floor, and the stand on which the milk vat is placed is only 4 feet from the floor of the separator room. The releaser is higher than usual and a concrete step on which to stand when dismantling the releaser has been built into the separator room floor.

The metal division between each unit is 4 feet high above the floor. No metal rail has been found necessary on the outside of the cow above the edge of the milker's alley to prevent her from falling into the alley or well.

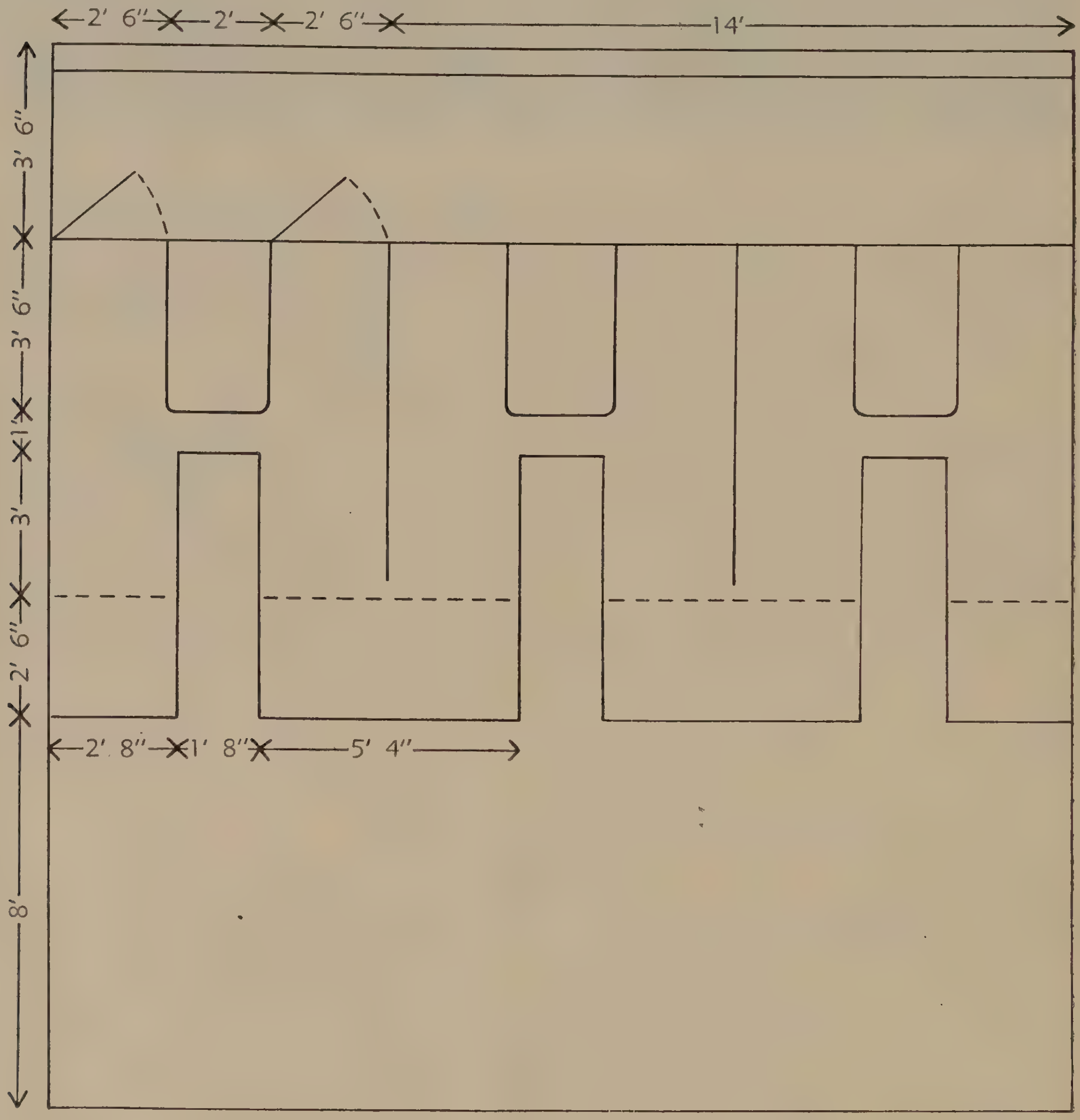


Plate 134.

Sketch of General Layout of 21 ft. x 18 ft. Milking Shed With Three-unit Elevated Bails.

In the erection of any milking shed an item that usually concerns the farmer most is the matter of expense. The only higher cost in the erection of the elevated bail is for extra cement. Mr. Schabe estimates that it took one ton more cement than the ordinary type of milking shed. Extra sand and rock were used to fill in the elevated portion of the bails and this was covered with a cement floor from three to four inches thick.

The general layout of the 21 feet by 18 feet milking shed and 3 feet 6 inch race is depicted in Plate 134.

After 12 months' trial Mr. Schabe has no desire to go back to the conventional type of milking shed. After a hard day in the field he finds the milking of his 45 to 50 cows an easy operation and he is as fresh at the finish of milking as he was at the start.

It is rather difficult to convey a complete picture of the elevated bail and give all its dimensions in an article. In order that it may be more clearly understood the dimensions are shown in Plate 135.

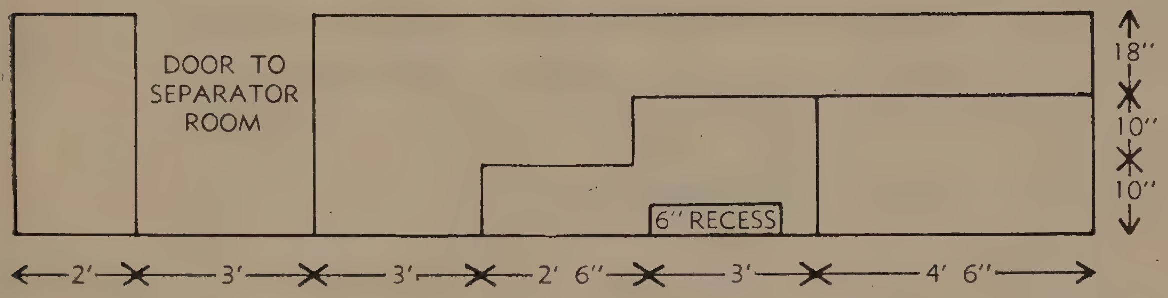


Plate 135.

Section Through First Bail, Showing Dimensions of Platform.

After having worked in his present milking shed for 12 months Mr. Schabe offers the following suggestions for improvements. Instead of having the engine room-separator room-refrigerator room section 18 feet wide as at present, he would extend it to bring it in line with the race in front of the bails. This extra space would allow the refrigerator to be moved back a couple of feet, and still be about 2 feet from the wall, thus allowing better circulation of air around the refrigerator and ease in sweeping and cleaning.

The extra width would allow more room around the wash-up section and this area could be better arranged.

Extra width in the separator room would be an advantage and make more room for the compressor of the refrigerator when housed in this section.

In the engine room (or air space) extra space would prove convenient for dairymen with home lighting plants where a generator and batteries are stored in this section. An auxiliary engine could also be included in the case of a breakdown.

The first step up to the platform is a little too wide and could conveniently be reduced from 2 feet 6 inches to 2 feet.

Herd Improvement Through Herd Recording.

S. E. PEGG, Division of Dairying.

IN general, in the first few years of production recording the main use made of the information received by the farmer is limited to attempting to improve production by the culling of low-producing cows and the rearing of calves from the higher producers, but experience in other countries has shown that the increased production gained by this means is very limited and the only manner in which any substantial increase can be achieved is by the selection of suitable herd sires.

One of the laws of breeding is that "the sire and dam play an equal part in the determination of the offspring." It is thus apparent that as the sire has a 50 per cent. representation in each of the offspring, he is the main factor in determining the productive ability of the future herd. For this reason it is necessary to give considerable thought to the buying of a bull for use in the herd.

What are the desirable characteristics in the daughters of a bull? Briefly, these are:—

(1) A high level of milk and butterfat production.

(2) Resistance to disease (good constitution).

(3) Fertility (ability to calve regularly each year).

(4) A long working life.

(5) A good milking temperament.

In order to obtain these qualities it is necessary, when purchasing a bull, to go to those purebred herds where they are most likely to be found in the stock. The level of milk and butterfat production may be readily ascertained by an examination of the factory returns and the testing records of the herd.

Resistance to disease is very important, and investigations carried out by the New Zealand Dairy Board's staff show that susceptibility and resistance to mastitis are definitely influenced by breeding, in the same manner that breeding influences the level of milk and butterfat production.

In connection with fertility, scientific investigations substantiate the claim that breeding plays a part.

A long working life is an essential, as most cows reach their maximum production at the age of five or six years, and will continue to produce a slightly declining yield each year from then on. It will be readily appreciated that it is unprofitable to rear an animal only to find that it becomes unproductive after two or three calves. As breeding affects the first three of the abovementioned qualities, it is obvious that it must also affect the length of the working life of an animal. The best evidence of a long working life is provided by test records of individual cows year after year. *Therefore, if possible, select a sire from animals which have continuous test records.*

A good milking temperament is becoming increasingly important in efficient utilisation of labour on dairy farms. Professor Petersen of U.S.A. emphasises that he obtained a very good correlation between daughters and dams in milking times.

Where is one most likely to find strains of dairy cattle likely to transmit these qualities?

If the breeder can demonstrate success in his own herd in breeding good lifetime qualities, then that herd is certainly a source of bulls likely to transmit those qualities in commercial herds.

If a bull is bought from a cow on appearance, but without any production records, then all one has is the inherent value of type, which is problematical. If she has a single high record of production, then nothing is known of her ability to stand up to sustained production.

If she has a good lifetime record, then at least a check can be made on one side of the pedigree for one generation of the qualities required. But even this is not good enough, as good breeding lines for commercial qualities are not built up in one generation.

If one can get progeny tests for the male ancestors and several generations of lifetime records for the female ancestors, the gamble on the bull transmitting suitable commercial dairy qualities is greatly reduced.

Breeders can assist in providing the abovementioned information by—

(*a*) testing every cow every year so that lifetime records of cows can be compiled and the qualities of the sire assessed;

(*b*) making available to the purchaser factory returns and testing records for the herd when discussing the sale of bulls;

(*c*) indicating the feeding policy in the herd, as it is essential to know under what conditions the records are produced.

Milking Machines—A Correction.

In some copies of the September issue of the Journal, Plate 99 was printed upside down. The longer of the teat-cup assemblies illustrated is the Ridd.

Tuberculin Testing of Dairy Herds.

Figures for tuberculin testing of milk supply herds by the Department of Agriculture and Stock show that during 1950-51, over 86,000 tests were made in 1,378 herds. The number of cattle which reacted to the test was 1,129, giving an average percentage of 1.31 reactors. Darling Downs and Beaudesert herds had very few reactors, their average being less than 3 in 1,000. Areas with less than 10 in 1,000 included Southport, North Brisbane and Petrie, Dayboro-Mt. Mee, Ipswich, Rockhampton and Kingaroy.

The figures indicate that continuous testing of herds for tuberculosis, with elimination of reactors, can reduce the incidence of the disease to a very low figure.

Dairy Building Competition Results.

THE 1951 Dairy Building and Equipment Competition conducted by the Department of Agriculture and Stock has been completed and the results have been announced by the Minister for Agriculture and Stock (Hon. H. H. Collins), who said that 76 entries were judged in the eight zones.

The judges reported that entries generally were of a high standard and some were of exceptional merit. Descriptions and photographs of the winning sheds will be used by the Department's Division of Dairying to stimulate interest in modern buildings and equipment throughout the dairying districts.

Mr. Collins said that farmers co-operating with the Department under the Commonwealth Dairy Efficiency Grant were ineligible for the competition, but their milking sheds are open for inspection by interested dairy farmers when field days are held from time to time on the farms concerend.

The prizewinners, who will share prize money of £387 from the Commonwealth Dairy Industry Efficiency Grant, are as follows:—

Zone 1.

1st Mr. A. McDougall, Veresdale.
2nd Mr. and Mrs. T. and E. Vayro, Flagstone Creek.
3rd Mr. E. Raabe, Forest Hill.

Zone 2.

1st Mrs. Julia Robinson, High street, Southport.
2nd Mr. C. W. Pope, Samford; and Mr. A. W. Houghton, Samford (equal).
3rd Messrs. Webb Bros., Woodford; and Misses Hannah and Daisy Storey, Logan Village (equal).

Zone 3.

1st Mr. L. C. Iseppi, Bowenville.
2nd Mr. I. B. Skerman, Kaimkillenbun.
3rd Mr. G. H. Lawrence, Taylor Road Mail Service.

Zone 4.

1st Messrs. Allen and Sons, Chatsworth.
2nd Mr. F. J. Fleiter, Conondale.
3rd Estate A. A. Alcorn, Witta road, Maleny.

Zone 5.

1st Messrs. Stollznow Bros., Bundaberg.
2nd Mrs. E. Powell, Box 37, Gin Gin.
3rd Mr. C. G. Luthje, Monto.
Special Mr. R. R. Jarvis, Mundubbera.

Zone 6.

1st Mr. N. D. Hill, Nagoorin.
2nd Messrs. W. Menkens and Son, Box 76, Home Hill.
3rd Mr. R. M. Bell, Dalrymple Heights.

Zone 7.

Only award Mr. T. B. Wright, Goomburra.

Zone 8.

1st Mr. J. F. Evans, Mongallon, via Malanda.
2nd Mr. R. S. Griffiths, Moregatta, via Millaa Millaa.
3rd Mr. D. E. Beattie, Malanda.

The Liver Fluke and Black Disease of Sheep.

S. J. MILLER, Husbandry Officer, Sheep and Wool Branch.

LIVER fluke infestation of sheep is not commonly found in Queensland, though a number of cases were reported from areas adjacent to the southern Darling Downs during the wet period of 1950. Where it occurs commonly, liver fluke may be of considerable economic importance, because, in addition to causing ill health and actually killing sheep on its own account, it renders affected animals susceptible to a serious disease known as black disease. This name comes from the black appearance of the under surface of the skin resulting from the filling of the blood vessels with dark blood.

LIFE CYCLE OF THE FLUKE.

It is necessary for the sheep owner to know something of the various stages in the complicated life history of the fluke in order to appreciate fully the measures that are necessary for its control.

The liver fluke is a flat worm, shaped somewhat like a leaf and about an inch long. Each fluke contains both male and female reproductive organs and is admirably adapted for the production of enormous numbers of eggs, each worm laying up to about 45,000. These eggs pass down the bile ducts of the infected animal into the bowel and thence to the exterior in the droppings. Under suitable moist conditions, such as in a slow flowing stream or in wet ground, the eggs hatch in a fortnight or longer to a minute embryo which is the intermediate stage between the egg and the adult fluke.

This intermediate stage must find a special fresh-water snail in which to develop further. It dies if unable to locate the particular snail within a day or so. Once established in the snail, various changes take place and within a few months very young flukes which are capable of infecting sheep emerge and attach themselves to blades of grass or water weeds. Here each young fluke encloses itself in a protective casing, and is said to be encysted.

After it has been swallowed by a sheep drinking or eating in an infested area, the young fluke penetrates the wall of the bowel and eventually bores its way into the liver. It wanders about in the liver tissue for about 10 weeks, causing a considerable amount of damage, and finally enters the bile tubes, where it grows to maturity.

Under favourable conditions the fluke completes its life cycle from the egg stage to the mature adult in five or six months.

It will be seen that conditions necessary for the propagation of the fluke in any area are:—

(1) The presence of a particular species of snail.

(2) The presence of the eggs of the fluke.

(3) The presence of slow flowing streams, springs, swamps or marshy ground.

(4) The presence of sheep.

DISTRIBUTION.

Liver fluke is most commonly found in sheep raising districts of the Commonwealth that are well watered by springs and creeks and have a heavier effective rainfall than that of the semi-arid districts of Queensland in which the great majority of our sheep are run. In this State, it has been recorded only from the Warwick-Stanthorpe area.

EFFECTS OF FLUKE INFESTATION.

Three different pictures may be seen in areas where fluke is present. These are referred to as acute fluke infestation, chronic fluke infestation and black disease.

Acute Fluke Infestation.

Acute fluke infestation is a condition resulting from liver damage caused by a large number of young wandering flukes. The sheep eat young flukes which have developed from eggs hatched about the spring of the year, and the effects of infestation are consequently seen from midsummer to late summer. Affected sheep are usually found dead without having shown symptoms. The principal post-mortem changes are enlargement and darkening of the liver, which may be covered with greyish shreds of clotted blood, and often the presence of bloodstained fluid in the body cavity.

Chronic Fluke Infestation.

In this form, the sheep begin to pick up young flukes about December and the infestation increases in the late summer and early autumn. Provided the infestation is not massive, the flukes will develop to maturity without the sheep succumbing. However, as it takes over two months for the flukes to mature, it follows that the sheep will not show marked symptoms of chronic fluke infestation until the winter. The main symptoms are anaemia (shown by paleness of membranes), bottlejaw, loss of condition and weakness. Post-mortem examination reveals emaciation, the liver is small and hard, the bile tubes are thickened, standing out like white pipes in the liver and containing adult flukes, and there is often much fluid in the body cavity.

Black Disease.

Black disease is an infectious disease. It is caused by bacteria which live in the soil, from which they reach the sheep's intestine and then the liver. They may stay in the liver for a long period in a harmless resting stage, known as the spore stage. The spores are stimulated into active growth through liver injury by young flukes, and when this happens the bacteria produce a poison which kills the sheep. The disease occurs only when both the bacteria and the fluke are present.

Unlike acute fluke infestation, which requires heavy infestation with young flukes, black disease can occur following even light infestations. Hence, though ordinary control measures may eliminate acute and chronic fluke disease, black disease can still occur as long as odd flukes are present in the sheep.

Sheep usually die quickly without showing symptoms. The post-mortem findings, which are fairly characteristic, include the following:—

(*a*) The blood vessels under the skin are engorged with dark blood, giving the impression of a black under-surface to the skin.

(*b*) The surface of the liver shows sharply defined yellowish-white areas from ¼ to 1½ inches in diameter.

(*c*) The heart sac contains straw-coloured fluid which may have formed a clot.

Mature flukes are seldom seen in cases of this disease.

Diagnosis.

The following table may be used to differentiate between the three forms of fluke disease.

Points to Consider.	Acute Fluke Disease.	Chronic Fluke Disease.	Black Disease.
Usual seasonal incidence	Midsummer to late summer	Late autumn and winter	Midsummer to late summer (checked by frost)
Condition of sheep..	Fat	Poor	Fat
Age of sheep ..	Adult	Adult	Adult
Symptoms	Sudden death	1. Weakness .. .. 2. Bottle jaw .. .. 3. Pale membranes .. 4. Pot belly .. .. 5. Loss of condition ..	1. May lag behind when driven 2. Die quickly
Post-mortem findings	1. Liver enlarged .. 2. Liver dark .. .. 3. Body cavity contains blood and stained fluid 4. *No mature flukes* .. 5. No necrotic areas ..	1. *Mature flukes* in bile tubes 2. Bile tubes like thick white pipes 3. Liver small and hard	1. No mature flukes 2. *Necrotic areas* on surface of liver 3. Fluid in heart sac

Although these diseases usually have the seasonal occurrence mentioned, it should be remembered that the young flukes encysted on the grass may remain alive for many months, especially in wet, swampy places. If sheep do not graze in these places until forced to do so by dry conditions, the flukes may not be picked up until some months after reaching the encysted stage. Acute fluke infestation and black disease in these circumstances may be seen even in late winter instead of summer.

CONTROL.

From what has been said of the life history of the fluke, it will be seen that the easiest ways in which the life history may be interrupted are by getting rid of adult flukes and by eliminating the snails concerned. Treatment of sheep and the adoption of measures for snail destruction will usually bring both acute and chronic fluke infestation under control, but it may not be possible to eliminate snails from a property, in which case the incidence of fluke may remain high enough to start an outbreak of black disease.

Treatment for Fluke Infestation.

Chronic fluke infestation can be controlled by drenching the sheep with carbon tetrachloride.

In badly infested areas, drenching should be carried out at the end of April, in the middle of June and at the end of July. In moderately infested areas, drenching in the middle of May and at the end of July should suffice, while in slightly infested areas a single drenching in the middle of June should prove adequate.

A dosage of 1 c.c. of carbon tetrachloride in 4 c.c. of liquid paraffin is effective against adult flukes in the bile tubes. This dose will overcome chronic fluke infestation but not acute infestations where young flukes are wandering in the liver tissue. If the dose of carbon tetrachloride is increased to 4 or 5 c.c. (that is, 10-12·5 c.c. of "double strength" or 20-25 c.c. of "single strength" drenches) the young fluke will be killed. However, there is some risk attached to giving large doses of carbon tetrachloride and they should not be used until the necessity for them has been definitely established by a veterinarian or field officer of the Division of Animal Industry.

Decreasing the Snail Population.

As was mentioned earlier, a special fluke-carrying snail is necessary for the completion of the life cycle of the liver fluke. The snail concerned is a quarter of an inch long and about one-sixth of an inch in diameter. It has a brownish, horn-coloured shell, and if placed on the hand with its opening down and the point facing towards the person holding it, the direction of the spiral is seen to be clockwise.

Snail destruction may be brought about either by draining swampy areas to eliminate breeding grounds, or by distributing bluestone. The method of approach will vary with the property, but three measures that can be taken are:—

(*a*) Broadcast bluestone powder at the rate of 20 lb. per acre, mixing with fine sand to facilitate even distribution.

(*b*) Spray a solution of bluestone (1 lb. in 5 gallons of water) around swamps, gullies, &c.

(*c*) Treat larger pools by dragging a bag of bluestone through them.

The time at which to use bluestone depends to a large extent on the life cycle of the snail and will vary slightly according to seasonal conditions. Used in September, it will kill the snails before the young flukes emerge; snails missed at this time may be killed by bluestone in January or February, before they start to breed. If the swampy areas are very large at these times because of heavy rains, it is advisable to wait until the areas have dried out somewhat before using bluestone.

Treatment of Black Disease.

The liver fluke control methods given above should be supplemented by vaccination against black disease. A vaccine is available which, injected in spring or early summer, enables the sheep to develop immunity before the disease is likely to make its appearance. Though the liver may still be damaged by young wandering flukes, and the bacteria which cause black disease may be present, the vaccination renders the sheep immune to the effects of the poison liberated by the black disease bacteria. Sheep vaccinated in two successive years are usually resistant to black disease for the rest of their lives.

SUMMARY OF CONTROL MEASURES.

Month.	Disease.	Control Measures.
January	Acute fluke and black disease	Use bluestone
February	ditto ..	..
March	ditto ..	..
April	ditto ..	..
May	ditto ..	..
June	Chronic fluke ..	Drench with carbon tetrachloride once, twice or three times as required
July	ditto ..	
August	ditto ..	
September	ditto ..	Vaccinate against black disease. Use bluestone
October	ditto ..	..
November	ditto ..	..
December	ditto ..	..

INFERTILITY IN DAIRY CATTLE.

As the first step in a co-ordinated plan aimed at solving the problem of infertility in dairy cattle, the States are to be asked to explore means of carrying out a survey of their dairy herds to determine the nature of the infertility being experienced.

This decision, the Minister for Agriculture and Stock (Honourable H. H. Collins) said recently, had been made at the initial meeting in Sydney of the technical committee appointed to investigate the problem. The Australian Agricultural Council, comprising Federal and State Ministers of Agriculture, at its meeting in Brisbane earlier this year, had agreed that the committee, comprised of representatives of each of the State Departments of Agriculture and the Commonwealth Scientific and Industrial Research Organization, should be appointed.

Mr. Collins said that the Queensland representative on the committee, Mr. A. L. Clay (Assistant Director of the Division of Animal Industry), had reported that the representatives of the various States had agreed that, while it was not possible at present to form a reliable estimate of the economic loss to the dairying industry through infertility, it was certain the loss was very considerable.

The committee felt that there was not enough factual information on the problem available at present to embark on any large-scale programme of research. Therefore, the first essential in a planned attack was a survey of the herds. It was realised, in this respect, that records now kept by dairy farmers were in most cases not as complete as desired, but this difficulty could be overcome initially by confining the survey to selected farms. It would be necessary to encourage more farmers to keep breeding records to ensure the ultimate success of the survey.

The Minister added that the committee felt its appointment represented the first stage of a positive approach to the problem, and members were hopeful that a solution would ultimately be provided.

School for Sheep and Wool Extension Officers.

(Brisbane, September 10-14, 1951.)

[*Opening Address by Mr. A. F. Bell, Chairman of the Queensland State Committee of C.S.I.R.O. and Under Secretary, Queensland Department of Agriculture and Stock.*]

THE holding of this school is a very important advance in the integration of science and practice.

The Executive and the Advisory Council of C.S.I.R.O. have, in the post-war years, given a great deal of thought to devising means for the more rapid translation of research findings into practice and last year it became possible to establish an Agricultural Research Liaison Section. This new section has been placed under the capable control of Mr. R. R. Pennefather who has had some years of very successful experience in the leading of a field extension unit in the Murrumbidgee Irrigation Areas.

The present school is the first of the Research-Extension Schools which will be instituted for the purpose of transmitting and discussing research findings in the various divisions of Agricultural Science. We in Queensland are very gratified that our invitation to hold the first school here was so readily accepted by C.S.I.R.O.

The cost of the school is being borne by the Wool Fund, and I am sure that the members of the wool industry will be pleased at the representative group attending. Twenty-eight interstate representatives of the Commonwealth and all mainland States are present, together with sixteen members of the Sheep and Wool staff in Queensland.

The large Queensland representation is due to the fact that the Director of Sheep Husbandry (Mr. G. R. Moule) has been conducting one of the periodic schools for his field staff and arrangements have been made for them to attend this school also.

Naturally it is not possible to cover the whole field of sheep and wool research in one school and future schools will take up other avenues. On this occasion emphasis will be placed on sheep numbers, breeding problems, and the methods and findings of the research workers which may be adopted by sheep breeders. In a country in which the flocks are periodically decimated by the effects of drought the rate at which the flocks may be built up again is quite as important as the improvement of the breed. Sessions will also be devoted to nutrition and drought feeding.

Lectures will be given by five research workers from the C.S.I.R.O., assisted by one from each of the Departments of Agriculture in New South Wales and Queensland, and the New South Wales University of Technology. Each lecture will be followed by a full discussion of the subject. The various State representatives attending the school are not only invited to enter into these discussions, they are expected to do so. Research and extension must be regarded as complementary and the best results will be obtainable only through close team work.

In the final analysis the research worker and the extension worker are paid from the same purse and mutual encouragement, understanding, and criticism will alone give good team work. If the extension worker feels that a particular piece of research is inadequate, or that

the findings are unlikely to be applicable under his particular conditions, then it is his duty to say so. Research workers, on the other hand, can greatly benefit by the contacts with the men who have their fingers so closely upon the pulse of the industry. This type of school affords an excellent opportunity to develop those close contacts.

So far I have referred only to the type of research which is known as ''applied research'' but we should never lose sight of the necessity for the conduct of a large proportion of ''pure research'' by organisations such as C.S.I.R.O.

To draw an analogy: The merchant marine has performed a very complex and most beneficial service to mankind but it must necessarily work along routes already charted. But if there had been no altruistic souls to support the idea of ships setting out on voyages of discovery, without hope of immediate practical gain, then the great discoveries of the Americas, Australia, and all the New World would never have been made.

If we are to advance the frontiers of our knowledge, and to provide the framework for the carrying out of applied research, then we must make provision for pure research on a generous scale. In this age, when the results of applied research are so apparent, people are prone to overlook the fact that the basis was laid by past workers in the field of pure research.

C.S.I.R.O. is charged with the responsibility of carrying out both these types of research and I hope it will always receive the necessary funds and encouragement to maintain an adequate proportion of pure reserach.

Finally, may I say that this school is valuable as indicating the complementary fields of responsibility of C.S.I.R.O. and the State Departments of Agriculture. Anyone with experience of successful extension activities knows that it is essential to speak to the producer with one voice; anything otherwise leads to confusion. At the same time an organisation such as C.S.I.R.O. is bettter equipped to conduct fundamental and long term researches than are the States. Both, however, necessarily carry out applied research and this is the common ground on which they meet. The conduct of schools such as this will ensure the ready interchange of ideas and knowledge.

The Vegetation of South-Eastern Queensland.*

D. A. HERBERT, D.Sc., Professor of Botany, University of Queensland.

THE pattern of the vegetation of Queensland is complex and slowly changing. There are three distinct elements in the flora—the Malaysian, represented in part by the rain forests, the sub-Antarctic, represented by the beech forests, and the Australian, represented by the eucalyptus forests and the drier communities of the interior. This does not imply that the two former elements are recent invasions or any less entitled to consideration as Australian vegetation than the eucalypts. They were well established here in the early Tertiary period as the types of vegetation that were suited to special climates, not only in the continent which at present has the familiar australioid shape, but in other land masses with which exchange of populations was geographically possible. From this point of view the rain forests are the Australian aspect of a great flora characteristic of tropical and sub-tropical high rainfall areas from south-eastern Asia to Polynesia. The beech forests are representative of the sub-Antarctic areas which extend from New Guinea to South America. The eucalyptus forests remain as characteristically Australian because, except for some areas in New Guinea, Timor and other islands to the north, there has not been the climatic scope for their extension, or if there has, it no longer exists.

Climatic changes from the early Tertiary onwards have redistributed the vegetation, enforcing large-scale retreats and favouring extensions of territory of types adapted to drier conditions. Beech forests, originally of much wider extent, now occupy a very limited area near the southern border of the State. The alpine vegetation has gone, as there are no suitable habitats in the Queensland area of the present, although the occurrence of southern Australian high moor types in New Guinea, and of Dracophyllum on Bellenden Ker in North Queensland, suggests its former occurrence. Rain forests occupy high rainfall strips along the coast, but dry scrubs further inland suggest stragglers in the retreat. The distribution of Eucalypts, characteristically best developed as a marginal strip and losing their dominance with increasing aridity towards the interior, indicates the catastrophe that overtook a former flora of very different distribution.

Changes in the vegetation pattern are still going on in Queensland. There are oscillations between the inland blue grass and Mitchell grass communities, and between Mitchell grass and saltbush. In some cases, and these are very obvious, the change appears to be unidirectional. Rain forests are encroaching on eucalyptus forests, tidal flats are colonized by mangroves, and mangroves may give way through various stages to land forests. Grassland and eucalyptus forest alike may be overwhelmed by brigalow (*Acacia harpophylla*), and brigalow may be succeeded by a dry type of rain forest. Some curious mixtures, inevitable where entirely different communities, usually mutually exclusive, are changing their boundaries, may sometimes be seen, as for example on Widgee Mountain in the McPherson Range, where rain forest epiphytes are growing on *Xanthorrhoea arborea,* the grass tree, in an area where the beech forest is encroaching on the territory of the Eucalypts.

* Reprinted from ''Handbook of Queensland,'' prepared for the 1951 Meeting of the Australian and New Zealand Association for the Advancement of Science.

Important though climate is in the distribution of vegetation types, from the cool mountainous habitats of southern Queensland to the tropical lowlands, and from the comparatively well watered coast to the desert of the western border, the pattern is greatly modified by soil types. In the subsequent generalized account of the plant communities of the south-eastern corner of the State, some outstanding examples will be mentioned. The communities will be grouped under the headings of Rain Forest, Mangroves, Strand Vegetation and Eucalyptus Forests, with some notes on freshwater swamps. The inland communities—grassland, saltbush, forests, scrubs and deserts—are beyond the scope of this paper.

Rain Forest.

Rain forest, the most luxuriant development of Queensland vegetation, reaches its peak where good soil and a heavy rainfall of about 60 inches or more per annum, well distributed throughout the year, give the right conditions for its exuberant growth. Such areas are discontinuous along the coast and adjacent highlands. They are most extensive from the Daintree River to the Tully River and west to the Atherton Tableland, from Mackay to Proserpine and west to the Eungella Range, in the district to the east of Gympie and south through the Blackall Range, and on the McPherson Range on the southern border of the State. In New South Wales it extends from the McPherson Range to the Richmond River, and recurs further south, notably in the Dorrigo area. These are all regions of high rainfall, but elsewhere there are rain forests of varying extent, occurrence tending to be determined by local favourable conditions of water supply, soil or shelter. Around Brisbane, for example, they occur along streams, in sheltered valleys, on southern slopes where insolation is reduced, and on rich retentive soils such as those derived from basalt. Examples may be seen along the road from Ashgrove to Mount Glorious. The influence of soil is often very marked. In the McPherson Range and on Tamborine Mountain the rain forest characteristic of the basalts and andesites often stops sharp at the rhyolite and trachyte, or perhaps continues as an attenuated "bastard scrub," a mixture of rain forest and open forest trees. Adequate water supply along stream courses may create favourable conditions for rain forest where the surrounding country supports only eucalyptus forests, but in such cases the development of epiphytes characteristic of forests of the high rainfall areas is comparatively scanty. Although it is customary to refer to the rain forests of Queensland and Northern New South Wales as tropical, this must not be taken to imply that the temperature conditions are those of the tropical lowlands. In the tropics there are pronounced differences between the plant associations of lowland and montane rain forests though in general appearance they have much in common. The rain forests of tropical lowlands, tropical mountains, and of extra-tropical Queensland, because of the general similarity in type and the possession of a great deal of floristic detail in common, may be grouped together as a Malaysian type because the affinities are predominantly with those of Malaysia.

Rain forests in their best development are dense forests of trees mostly from 90 to 120 feet high, standing close together with their roots interlaced and their tops forming a continuous canopy so that there is a twilight gloom at midday stabbed by occasional shafts of sunlight. The low light intensity, often less than one two-hundredth of that in a

clearing, is responsible for the comparative dearth of small plants, but where there is a little extra light filtering through a gap in the canopy, thickets of seedlings—wild raspberries, nettles, lawyer vines (*Calamus*), and a host of tree seedlings—form dense tangles. When finally one fills the gap, the others, starved for light, either die or hang on to a life of light-poverty. A characteristic of rain forest trees is a suppression period in the early years; they may persist under heavy shade for many years, little more than a few inches in height, and shoot up when an opportunity finally presents itself. Eucalypts, intolerant of shade, cannot enter the rain forest, though on its margin they may attain a great size. Rain forest, on the other hand, may invade Eucalyptus forest provided moisture conditions are suitable.

The deep shade of rain forests causes death and self pruning of the lower branches of the trees and the trunks are characteristically straight and clean. The difficulty of distinguishing the foliage makes it necessary to recognize species by other characters such as bark texture, colour, scent, fluting and buttressing. Buttressing is particularly striking; many species flare out at the base into broad plank-like triangles between the horizontal roots and the trunk. In the carrabin (*Sloanea woollsii*) the buttresses may be twelve feet or more high and convex on the outer edge. In the booyong (*Tarrietia argyrodendron*) they are smaller and concave. The lignum vitae (*Vitex lignum-vitae*) has an angular fluted trunk. Conspicuous in the rain forests are the strangling figs or banyans, such as the green-leaved Moreton Bay fig (*Ficus watkinsiana*). The seed germinates on the branches of other trees, forming a seedling with a lignotuber. A long root drops down to the ground; others follow and anastomose to form a root-cage round the host trunk, finally strangling it and leaving the canopy of fig branches perched high on a convoluted trunk of fused roots. *Quintinia sieberi,* the possum wood, germinates on tree ferns and behaves in a similar way.

Woody lianas are another feature. *Calamus muelleri,* the lawyer vine, is a climbing vine notorious because of its barbed whips. Some of the woody lianas, notably species of *Vitis,* are known as water vines because when cut into billets they yield considerable quantities of water. *Pothos loureiri,* a soft-stemmed araceous climber that often clothes the tree trunks with dense masses of foliage, is easily recognised by the fact that the winged petiole is larger than the lamina. Epiphytes vary considerably in their occurrence. Some trees support heavy aerial gardens of ferns, orchids, mosses and lichens, while others are comparatively free. From the point of view of size the species of *Platycerium* (elkhorns and staghorns), the bird's nest fern (*Asplenium nidus*) and the king orchid (*Dendrobium speciosum*) are of special interest. The peat-tanks of the Platyceriums are a root-hold for numerous small plants and even tree seedlings with feeble epiphytic powers.

The fern flora of the rain forest is very rich. Hymenophyllaceae (filmy ferns) are characteristic of the dampest parts. Epiphytic species of *Polypodium, Asplenium,* and other genera clothe tree trunks. The prickly tree-fern (*Alsophila leichhardtiana*) is common. A maiden hair fern (*Adiantum formosum*) with fronds up to four feet in height forms dense masses in more open situations. Marestails (*Asplenium adiantoides*) hang from the bird's nest ferns and elkhorns, along with the haresfoot (*Davallia pyxidata*) or very occasional ribbon fern (*Ophioglossum pendulum*).

Rain forests have a wealth of tree species. The best guide is "Australian Rain Forest Trees," by W. D. Francis. Important genera are *Agathis* (kauri pine), *Araucaria* (*A. cunninghamii*, the hoop pine), *Castanospermum*, *Cedrela* (*C. toona* var. *australis*, red cedar), *Cinnamomum*, *Cryptocarya*, *Dysoxylum*, *Elaeocarpus*, *Endiandra*, *Eugenia*, *Ficus*, *Flindersia*, *Grevillea*, *Litsea*, *Sloanea*, *Tarrietia*, and *Weinmannia*. These, however, are only a few of the genera, and familiarity comes only with long experience. There is one genus, however, that the visitor should learn to recognize on first sight. It is *Laportea*. *Laportea gigas*, the stinging tree, ultimately attains a height of 120 feet, with a soft wooded, fluted and buttressed trunk. It has large heart-shaped leaves up to a foot long and nine inches wide, covered with stinging hairs. *L. moroides*, a shrub, has similar leaves and is probably even more irritating. The shining leaved stinging tree, *L. photiniphylla*, has glossy leaves rather like those of a white mulberry and is less easily recognised. Herbaceous nettles (*Urtica* species) are also common, but their sting, though annoying, is not as violent as that of *Laportea*.

In the McPherson Range, mostly at elevations over 3,000 feet, and where the moist south-easterly winds bring mists and heavy rain to the mountains, the Malaysian rain forest grades into forests of antarctic beech (*Nothofagus moorei*). These trees are for the most part old and gnarled, and heavily invested with moss and lichen. The old trunks tend to decay and to be replaced by coppice growth. *Callicoma serratifolia*, a common rain forest tree, is found with the beeches and in this foggy habitat has the same habit of growth. These forests are the equivalent of the moss forests that replace the montane rain forests of the extra-Australian tropics in the cloud belts, though here they are strongly sub-Antarctic in their general floristic composition.

At the other end of the series from beech and the wet type of rain forest is what is often known as dry scrub, scrub being the unfortunate name usually applied to rain forest in Queensland. In areas with a rainfall down to about 35 inches per annum, the rain forest becomes attenuated. Lianas and epiphytes become increasingly rare and the trees become smaller. Many of the species and genera disappear. Crows ash (*Flindersia australis*), lignum vitae (*Vitex lignum-vitae*), booyong (*Tarrietia argyrodendron*) and silky oak (*Grevillea robusta*) are amongst the survivors, but they are smaller than in the coastal rain forests. There is a tendency for such dry scrubs to succeed brigalow (*Acacia harpophylla*) scrubs, their tree species being able to survive the dense shade of this community. It is a peculiar fact that the dry scrub often grows where eucalyptus forest might be just as successful. It seems that we have here two different types, the eucalyptus forest developing in response to the climatic conditions, and the dry scrub representing the residue of more resistant rain forest types, both being quite well suited to the same environment.

Typically rain forest stops quite sharply and there is a narrow ecotone perhaps only a few yards wide between it and the entirely different open eucalyptus forest. There are considerable areas, however, of so-called bastard scrub—eucalyptus forest that is gradually proceeding to a rain forest climax by infiltration of rain forest types. The stage is ultimately reached where the shade swings the balance in favour of rain forest. This may be observed in the coastal area at the foot of the Blackall Range, where the blackbutt (*E. pilularis*) forest may be seen along the road in various stages of evolution towards rain forest.

Mangroves.

These forests of the sea are found along the coast on muddy, tidal flats and banks, especially where large slow rivers flow into quiet bays. Their roots are submerged at high tide and young plants may be entirely covered. River mangroves extend upstream to the tidal limits, but not into fresh water. The greatest mangrove development is in the tropics, adjacent to areas where rainfall favours rain forest. There the trees range in size according to species, age and position from 6 feet to 70 feet or more in height. The number of species and the size of individual trees are markedly reduced beyond the tropics and along dry tropical coasts, but mangrove forests are still well developed and aggressive in south Queensland. Their members are an ecological and not a taxonomic group; *Rhizophoraceae* predominates in the number of species, but the trees include members of other widely separated families. The peculiar ecological conditions of the habitat include the initial difficulties of establishment where tides rise and fall, a marked fluctuation in salinity of the soil (about 3 per cent. at high tide, rising to 8 per cent. or more at low tide), deficient aeration in the mud, direct and reflected light, and winds.

In Moreton Bay, which may be taken as typical of south Queensland, there are seven tree species of mangrove—*Aegiceras corniculatum, Avicennia marina* var. *resinifera, Bruguiera gymnorrhiza, Ceriops tagal* var. *australis, Excœcaria agallocha, Lumnitzera racemosa* and *Rhizophora mucronata.* The commonest is *Avicennia,* the white mangrove, which is usually the first colonist of mud banks and may form forests over 40 feet in height. Its shallow horizontal roots are lined with erect pneumatophores which project several inches above the mud. *Avicennia* and *Aegiceras* also grow densely along the tidal reaches of the rivers, where in places *Crinum pedunculatum* and a fern (*Acrostichum speciosum*) occur with them. Both absorb considerable amounts of salt, and *Aegiceras,* which is a shrub up to 15 feet high, secretes it from the leaves, which are characteristically frosted with small crystals. *Bruguiera,* the black mangrove, is usually on the landward side of the mangrove forest, and is not a pioneer; its shallow roots loop out of the mud at intervals, forming "knees." *Ceriops,* without pneumatophores, grows in sandier situations; the trees attain 15 feet in height, but are often only half that stature, and they are buttressed at the base. *Excœcaria* (Euphorbiaceae), the milky mangrove, occurs on the landward side, sometimes on dry land; its latex has the reputation of being poisonous and of causing temporary blindness if splashed in the eyes. *Rhizophora,* the red mangrove, is recognised by the prop roots which curve outwards from the trunks or drop from the branches. *Rhizophora* and *Bruguiera* are used for tanbark by fishermen.

These mangroves, with the exception of *Excœcaria,* are viviparous, i.e., the seed germinates while the fruit is still on the tree. In *Avicennia* and *Aegiceras* the seedling remains in the capsule until after the fruit has fallen. In *Rhizophora, Bruguiera* and *Ceriops,* the seedlings burst from the fruit and may be a foot long before they fall; in *Rhizophora* they may occasionally reach 3 feet in length. These developed seedlings are a common feature of drift along the beaches. Their advanced growth considerably reduces the hazards of establishment on newly formed mud banks, the formation and colonization of which often synchronize.

The successional series in Moreton Bay usually starts with *Avicennia*, sometimes with *Rhizophora*. *Aegiceras* and *Ceriops* come later. Along rivers *Aegiceras* appears on the landward side of *Avicennia*. *Ceriops* comes in mainly in more sandy flats. *Bruguiera* is a fairly late arrival and often abuts on the strand forest. *Excœcaria* usually occurs at high tide mark, or even beyond. It is not viviparous, and although found on drier ground, it is still a mangrove as it can cope with the osmotic fluctuations of the mangrove habitat.

Though the immediate utility of mangroves is the holding of banks and the maintenance of watercourses, they have the added function of slowly paving the way for dry land forest. This may take place in two directions. The first is the establishment of strand forest including *Casuarina equisetifolia* var. *incana*, *Hibiscus tiliaceus* and *Thespesia populnea* after the *Excœcaria* or *Bruguiera* stage when the soil is no longer subjected to the tides; and the second is through the development of salt marsh and salt meadow. Salt marsh is on flat country, which tends to dry out and crack in between flood tides and develop a high salinity. Here the Avicennias fail, and their dead stumps are left amongst *Salicornia australis* and other succulents such as *Suaeda*, *Arthrocnemum* and *Sesuvium* taking part in the sere. The tendency is for the salt marsh to give way to salt meadow, which is essentially a sward of the saltwater couch, *Sporobolus virginicus*. There are fringing zones of *Fimbristylis polytrichoides* on the salt marsh side, and on the landward side various other sedges such as *Cyperus polystachyus*. After the salt meadow stage comes *Casuarina glauca*, the swamp oak, ushering in the land forest.

Strand Vegetation.

The common sand binders of the coastal dunes are *Ipomoea pes-caprae*, the goat's foot convolvulus, with purple flowers and runners that reach high tide mark, *Vigna lutea*, a yellow-flowered legume, and *Canavalia obtusifolia*, a purple flowered sword bean. *Acacia longifolia* var. *sophorae*, with prostrate stems up to about 12 feet long, is common in places. Amongst the grasses are *Spinifex hirsutus*, the round inflorescences of which often blow along the beach, *Zoysia pungens* (the coastal couch), *Ischaemum triticeum*, *Lepturus repens*, and *Stenotaphrum subulatum*. Succulent plants include *Mesembryanthemum aequilaterale* (pigsface), *Cakile maritima*, *Scaevola suaveolens*, *Euphorbia atoto* and *Euphorbia eremophila*. Trees of the dunes that occur on the more stable soils include the coastal sheoak, *Casuarina equisetifolia* var. *incana*, and the two screw pines, *Pandanus odoratissimus* and *Pandanus pedunculatus*. The screw pines, locally known as bread fruit, are remarkable for their stout prop roots with large root caps like corky egg cups. *Banksia integrifolia* is found on the more stabilized dunes. Behind them the sand cypress or Bribie cypress (*Callitris columellaris*), often wind-shorn at the top, is common in places.

Elsewhere on the more stabilized parts of the coast the land forest may abut directly on a narrow fringe of strand trees including *Hibiscus tiliaceus* (the cotton tree), *Casuarina equisetifolia* var. *incana*, *Thespesia populnea* and *Pandanus*. Occasionally in this strip may be found *Sophora tomentosa*, a leguminous tree conspicuous for its constricted pods. In heavy rainfall areas, rain forest may start immediately behind the sheoak and cotton tree fringe with or without dwarfing and wind-shearing and with the incidence of epiphytes varying according to the amount of shelter.

Eucalyptus Forests.

The limits of the range of eucalyptus forests are determined by aridity in the west, and by the competition of the dense rain forests in high rainfall areas along the coast. Within this range they may be suppressed by brigalow (*Acacia harpophylla*) or by the type of rain forest usually known as dry scrub, both of which form a canopy with lighting conditions unfavourable to eucalypt establishment. The trends of the eucalyptus forests between the rain forest and the mulga scrub, or from the southern border to the tropical north, are complicated by the influence of soil types which may produce amazing variation in a very small area.

In the vicinity of Brisbane, common species are *E. maculata* (spotted gum), *E. tessellaris* (Moreton Bay ash), *E. micrantha* (scribbly gum), *E. tereticornis* (blue gum), *E. propinqua* (grey gum), *E. hemiphloia* (gum-topped box), *E. resinifera* (red stringybark), *E. acmenioides* and its allies *E. carnea* and *E. umbra* (yellow stringybarks), *E. microcorys* (tallow wood), *E. crebra* (narrow-leaved ironbark), *E. paniculata* (grey ironbark), *E. gummifera* (red bloodwood), and *E. trachyphloia* (white bloodwood). With them occur two allied genera, *Tristania* and *Angophora*. *T. conferta* (Brisbane box) and *T. suaveolens* (swamp mahogany, which also extends up the hillsides) are found in very diverse situations, and are two of the commonest trees of the area. *Angophora lanceolata* (rusty gum, sometimes called red gum) of the hillsides is a rather different tree from that seen further south in New South Wales; on the flats *A. woodsiana* (apple) often mingles with *E. tereticornis*. These two genera are regarded as normal constituents of the coastal Eucalyptus forests, because of their ubiquity and general habit of growth.

Tristania conferta varies from a shrub in such localities as the less exposed dunes on Moreton Island to an average tree of the eucalyptus forests around Brisbane, and finally a forest giant of 150 feet or more on rain forest edges. It grows in the McPherson Range at an altitude of over 2,500 feet, at sea level in tropical North Queensland, and enters into the most diverse associations. In a list of plants from any area, its recording by name only does not suggest the plasticity of habit of this species in harmonizing with its associate trees. Other common trees of the eucalyptus forests are *Casuarina torulosa* (forest oak), *Alphitonia excelsa* (red ash), *Acacia cunninghamii* (Brisbane black wattle), and *A. aulacocarpa* (hickory wattle). Amongst the more sporadic Australian types are *Exocarpus, Lomatia, Hakea, Jacksonia* and *Persoonia*. The orchids *Cymbidium suave* and *C. iridifolium* are fairly common in the hollows of broken branches of eucalypts, their roots often extending for yards in the decayed material of the trunk.

The characteristic trees of the watercourses in eucalyptus forests in south-eastern Queensland include *Eucalyptus tereticornis* (blue gum), *Casuarina cunninghamiana, Eugenia ventenatii* (weeping myrtle or water gum), *Callistemon viminalis* (red bottlebrush), *Melaleuca bracteata* (river tea tree) and *Castanospermum australe* (black bean). Where the streams rise in rain forest country there is a tendency for a considerable number of rain forest tree species to join the more usual assemblage. All gradations from the typical creek trees of the eucalyptus forests to fringing rain forest may occur along the same watercourse.

On the margins of true rain forest, tall eucalypts including *E. resinifera, E. microcorys, E. paniculata,* and *E. grandis* mixed with *Tristania conferta* and *Casuarina torulosa* have a characteristic undergrowth of ferns such as *Davallia dubia* and *Doodia aspera,* wild ginger (*Alpinia caerulea*), yams (*Dioscorea transversa*), *Smilax australis, Duboisia myoporoides, Alyxia ruscifolia, Homalanthus populifolius* and many others. It is in this shaded habitat, the ecotone between the two types of forest, that many rain forest trees find a foothold, so that slowly the rain forest extends its territory. The eucalypts, on the other hand, are unable to penetrate the rain forest because of their intolerance of shade. To the north of Brisbane this tendency for the supplanting of the eucalypts is seen in the blackbutt (*E. pilulifera*) country. The undergrowth paves the way for *Rhodamnia trinervia* (scrub stringybark), *Diploglottis cunninghamii* (native tamarind), *Elaeocarpus cyaneus* (blue quandong), and other trees, and finally a rain forest climax is established. The whole series may be traced along the highway between Caloundra and Nambour.

In the Stanthorpe area, the cold spot of Queensland, which is an extension of the New England tableland, there is a distinct southern representation, including *E. macrorrhyncha, E. andrewsii, E. melliodora, E. obliqua, E. stuartiana,* and *E. rubida.* Most of these fail in the McPherson Range, where the rain forest is occupying comparable altitudes. On the trachytic and rhyolitic soils, however, some such as *E. andrewsii* and *E. oreades* attain giant proportions with no danger of being overwhelmed.

In the Dave's Creek country of the McPherson Range there is a remarkable development of mallee heath under high rainfall conditions. It is within a mile of beech forest. Here partly surrounded by a mixed community of eucalypts and rain forest trees, there is an area of hungry soil derived from a volcanic glass. The dominant Eucalypts are two mallees, *E. condonocarpa* and a form of *E. resinifera,* the latter a large tree on rhyolitic and trachytic soils. With them are dwarf shrubs of the genera *Casuarina, Callitris, Callistemon,* and characteristic heathland Epacrids, Rutaceae and hardy ferns. Over considerable areas of this volcanic glass the collection is reduced by absence of the mallees and larger shrubs to heathland. This mallee heath is a curiosity because of its limited occurrence in an area otherwise dominated by heavy forest.

Along the coast there is another type of country where soil conditions result in a different modification of the eucalyptus forests. This is the wallum. The term is applied in a general way to the sandy coastal belt from the border to the tropic of Capricorn. The wallum (*Banksia aemula*) is the characteristic tree. The area is one of extensive treeless flats, interspersed with peat swamps (occasionally with *Sphagnum*) drained by slow creeks, and rolling sandy ridges. The flats are covered by a heath with species of *Leptospermum* (including *L. scoparium* and the lemon scented *L. liversidgei*), *Boronia, Eriostemon, Epacris, Sprengelia, Conospermum,* etc. The true wallum is a little higher in ground level and continues up the sand ridges. *Banksia aemula* is characteristic, but stunted eucalypts including *E. gummifera, E. micrantha,* and *E. seeana* are common; here, too, occur many of the showy spring wild flowers, including *Aotus villosa, Ricinocarpus pinifolius, Sowerbœa juncea* and *Hibbertia linearis.* Along the streams *Eucalyptus robusta* and *Melaleuca viridiflora* (paper-bark tea tree) are usually common with a close ground cover of *Gleichenia, Halorrhagis,*

Comesperma, and other small plants. Not infrequently the parasitic vines of *Cassytha* make a dense and almost impenetrable tangle; where the area has been fired this plant is much less troublesome. Wallum is essentially a poor-country type of vegetation. There is a marked response to applications of phosphates, zinc and copper, but it is comparatively useless for cultivation. Gradations from wallum to better type soils occur in places. Along the north coast the better class sandy ridge soils with the addition of phosphatic fertilizer are used for the growth of exotic pines, mainly *Pinus caribaea* and *P. taeda.* In the Glasshouse Mountains area, the sandy ridges are capped with a red sandy loam of considerable depth normally carrying a fairly heavy eucalyptus forest. These loams, which are a gradation from the barren sandy soils, are used for pineapple growing. With increasing fertility wallum may grade into blackbutt forest, from which the trend is towards rain forest.

Freshwater Swamps.

Tea tree swamps are of such common occurrence close to the shore in southern Queensland that they deserve special brief outline. They are in their typical form dominated by paper bark tea tree, mostly *Melaleuca viridiflora,* and the swampy floor is carpeted with *Blechnum serrulatum* (bungwall fern). In the deeper water there are *Nymphaea* spp. (the yellow flowered *N. flava* being a naturalized alien from Florida), *Limnanthemum indicum* (fringed water lily) with *Sparganium angustifolium* (burr reed), sedges and Restiaceae towards the margins. The introduced water hyacinth (*Eichhornia crassipes*) may form a dense cover. Bordering the swamps such grasses as *Paspalum distichum* (water couch), *Leersia hexandra* (rice grass) and *Phragmites communis* (common reed) mix with the water peppers (*Polygonum* spp.). These swamps are, of course, developmental communities, and the gradation is from *Melaleuca* through *Tristania suaveolens* (swamp mahogany) and perhaps *Casuarina glauca* to the local climax.

WHALE SOLUBLES IN STOCK FEEDING.

A product of the Australian whaling industry, known as ''whale solubles,'' may prove of use in reducing the amount of protein-rich concentrates of animal origin now required for stock feeding in Australia.

The Minister for Agriculture and Stock (Hon. H. H. Collins) said recently that feeding trials with both pigs and chickens were being conducted at Yeerongpilly Animal Health Station to determine whether whale solubles in conjunction with vegetable proteins such as peanut meal and linseed meal can be effectively and economically used to replace most of the animal protein now being fed in rations for these animals.

Mr. Collins explained that hitherto fairly large proportions of animal proteins had been considered necessary to supply essential food materials, including one of the most recently discovered vitamins. Fish solubles in small quantities are being used overseas to replace much of the animal protein concentrate in stock rations, and the work now in progress is designed to show whether the feeding of whale solubles can be applied here. The use of fish meal in Australia is limited by the amount available. There is no large fishing industry and the amount of by-products at centres of distribution is usually too small and of unsuitable quality.

If the whale product proves suitable and can be produced in sufficient quantity, it will relieve the animal protein shortage which now exists.

Brucellosis Testing of Swine.

The Department of Agriculture and Stock is operating a scheme whereby pig herds are tested at intervals for the occurrence of swine brucellosis (contagious abortion).

A herd listed by the Department as "brucellosis tested" is one in which all such animals as may be determined by the Director of the Department's Division of Animal Industry have been subjected to two successive tests for brucellosis, at intervals determined by him, without any positive reactors being found.

In order for a herd to be retained on the list of Tested Herds, a semi-annual or annual re-test of the herd, as determined by the Director, is required. If at a re-test any animal gives a positive reaction to the test the herd is removed from the list; it is not listed again until subsequent tests, as determined by the Director, have been carried out.

Full particulars of the Brucellosis Testing of Swine and application forms may be obtained from the Under Secretary, Department of Agriculture and Stock, William Street, Brisbane.

TESTED HERDS.
(AS AT 19th SEPTEMBER, 1951.)

Breed.	Owner's Name and Address of Stud.
Berkshire	S. S. Ashton, "Scotia" Stud, Pittsworth
	J. J. Bailey, "Lucydale" Stud, East Greenmount
	S. Cochrane, "Stanroy" Stud, Felton
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	G. Handley, "Handleigh" Stud, Murphy's Creek
	J. L. Handley, "Meadow Vale" Stud, Lockyer
	R. G. Koplick, "Melan Terez" Stud, Rochedale
	H. V. Littleton, "Wongalea" Stud, Crow's Nest
	O'Brien and Hickey, "Kildurham" Stud, Jandowae East
	E. Pukallus, "Plainby" Stud, Crow's Nest
	G. C. Traves, "Wynwood" Stud, Oakey
	E. Tumbridge, "Bidwell" Stud, Oakey
	Westbrook Farm Home for Boys, Westbrook
	H. W. Wyatte, Rocky Creek, Yarraman
	H.M. State Farm, "Palen Creek," Palen Creek
	A. R. Ludwig and Sons, "Cryna" Stud, Beaudesert
	H. H. Sellars, "Tabooba" Stud, Beaudesert
	F. Thomas, "Rosevale" Stud, Beaudesert
	Bowkett and Meacle, "Myola Vale" Stud Piggery, Burra Burri, Jandowae
	D. T. Law, Trouts Road, Aspley
	R. J. McCullough, "Maxholm" Berkshire Stud, Gatton
	C. F. W. and B. A. Schellback, "Redvilla" Stud, Kingaroy
Large White	H. J. Franke and Sons, "Delvue" Stud, Cawdor
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	F. L. Hayward, "Curyo," Jandowae
	J. A. Heading, "Highfields," Murgon
	K. B. Jones, "Cefn" Stud, Pilton
	R. G. Koplick, "Melan Terez" Stud, Rochedale
	R. Postle, "Yarralla" Stud, Pittsworth
	E. C. Smith, "Smithfield" Stud, Coomera
	E. J. Bell, "Dorne" Stud, Chinchilla
	A. G. Fry, "Birubi" Stud, Dalby
	N. E. Meyers, Halpine Plantation, Kallangur
	L. C. Lobegeiger, "Bremer Valley" Stud, Moorang, via Rosewood
	J. H. G. Blakeney, "Talgai" Stud, Clifton
	V. P. McGoldrick, "Fairymeadow" Stud, Cooroy

TESTED HERDS—continued.

Breed.	Owners Name and Address of Stud.
Tamworth	S. Kanowski, "Miecho" Stud, Pinelands N. R. Potter, "Actonvale" Stud, Wellcamp D. F. L. Skerman, "Waverley" Stud, Kaimkillenbun A. C. Fletcher, "Myola" Stud, Jimbour L. C. Lobegeiger, "Bremer Valley" Stud, Moorang, via Rosewood P. V. Campbell, Lawn Hill, Lamington Salvation Army Home for Boys, Riverview F. Thomas, "Rosevale" Stud, Beaudesert A. J. Surman, Noble Road, Goodna
Wessex Saddleback ..	W. S. Douglas, "Greylight" Stud, Goombungee K. Day and P. Hunting, "Kazan" Stud, Goodna E. Sirrett, "Iona Vale" Stud, Kuraby C. R. Smith, "Belton Park" Stud, Nara H. H. Sellars, "Tabooba" Stud, Beaudesert H. Thomas, "Eurara" Stud, Beaudesert D. T. Law, Trouts Road, Aspley G. J. Wilson, "Glenbella" Stud, Silverleigh

HAVE YOUR SEEDS TESTED FREE

The Department of Agriculture and Stock examines FREE OF CHARGE samples representing seed purchased by farmers for their own sowing.

The sample submitted should be representative of the bulk and a covering letter should be sent advising despatch of the sample.

MARK YOUR SAMPLE

Sample of .... seed
Drawn from .... bags
Representing a total of ....
Purchased from..
Name and Address of Sender
Date...........................

SIZE OF SAMPLE

Barley -	8 oz.	Oats -	8 oz.
Beans -	8 oz.	Peas -	8 oz.
Grasses	2 oz.	Sorghum	4 oz.
Lucerne	4 oz.	Sudan -	4 oz.
Millets	4 oz.	Wheat -	8 oz.

Vegetable Seeds - ½ oz.

SEND YOUR SAMPLE TO—**STANDARDS OFFICER, DEPARTMENT OF AGRICULTURE AND STOCK, BRISBANE.**

ASTRONOMICAL DATA FOR QUEENSLAND.

NOVEMBER.

Supplied by W. J. Newell, Hon. Secretary of the Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			Minutes later than Brisbane at other places.					
Day.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	4·59	6·05	Cairns	45	12	Longreach	42	28
6	4·55	6·09	Charleville ..	29	25	Quilpie	33	37
11	4·52	6·12	Cloncurry	61	38	Rockhampton ..	17	3
16	4·50	6·16	Cunnamulla ..	28	31	Roma	18	15
21	4·48	6·20	Dirranbandi ..	17	21	Townsville ..	37	12
26	4·47	6·24	Emerald	26	13	Winton	49	31
30	4·46	6·27	Hughenden ..	46	24	Warwick	3	6

TIMES OF MOONRISE AND MOONSET.

At Brisbane.

Day.	Rise.	Set.
	a.m.	p.m.
1	5·41	8·05
2	6·34	9·14
3	7·34	10·19
4	8·40	11·16
5	9·49	..
		a.m.
6	10·57	12·05
	p.m.	
7	12·02	12·46
8	1·04	1·22
9	2·04	1·55
10	3·03	2·26
11	4·01	2·57
12	5·00	3·29
13	5·58	4·03
14	6·58	4·41
15	7·56	5·23
16	8·50	6·10
17	9·40	7·01
18	10·25	7·56
19	11·05	8·51
20	11·40	9·47
21	..	10·42
	a.m.	
22	12·12	11·37
		p.m.
23	12·42	12·32
24	1·11	1·28
25	1·40	2·26
26	2·12	3·27
27	2·48	4·32
28	3·30	5·42
29	4·19	6·54
30	5·17	8·02

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

Charleville 27; Cunnamulla 29; Dirranbandi 19; Quilpie 35; Roma 17; Warwick 4.

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Day.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	29	10	44	24	19	0	52	27
6	27	12	43	26	18	1	50	29
11	15	22	30	38	6	13	35	44
16	9	30	25	45	0	21	26	54
21	14	25	29	41	4	16	33	48
26	23	14	39	30	14	5	45	34
30	30	9	46	23	21	0	54	26

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	54	4	67	33	51	19	44	5
3	56	2	68	32	52	17	46	3
5	53	8	67	36	50	21	44	8
7	43	13	59	39	44	24	36	13
9	31	24	51	46	35	32	25	21
11	20	36	43	55	28	40	17	31
13	10	46	37	61	22	47	9	38
15	3	53	34	66	18	51	4	44
17	2	56	33	67	17	53	3	46
19	8	51	36	64	21	50	8	43
21	17	43	41	59	26	45	15	36
23	22	33	45	54	30	38	19	29
25	33	23	52	45	37	30	27	20
27	43	11	60	38	45	23	36	11
29	53	3	67	32	50	18	44	4
30	56	2	68	32	52	17	46	3

Phases of the Moon.—First Quarter, 6th November, 4.59 p.m.; Full Moon, 14th November, 1.52 a.m.; Last Quarter, 22nd November, 6.1 a.m.; New Moon, 29th November, 11 a.m.

On the 15th the sun will rise and set about 20 degrees south of true east and true west respectively, and on the 10th the moon will set at true west and will rise near true east on the 24th.

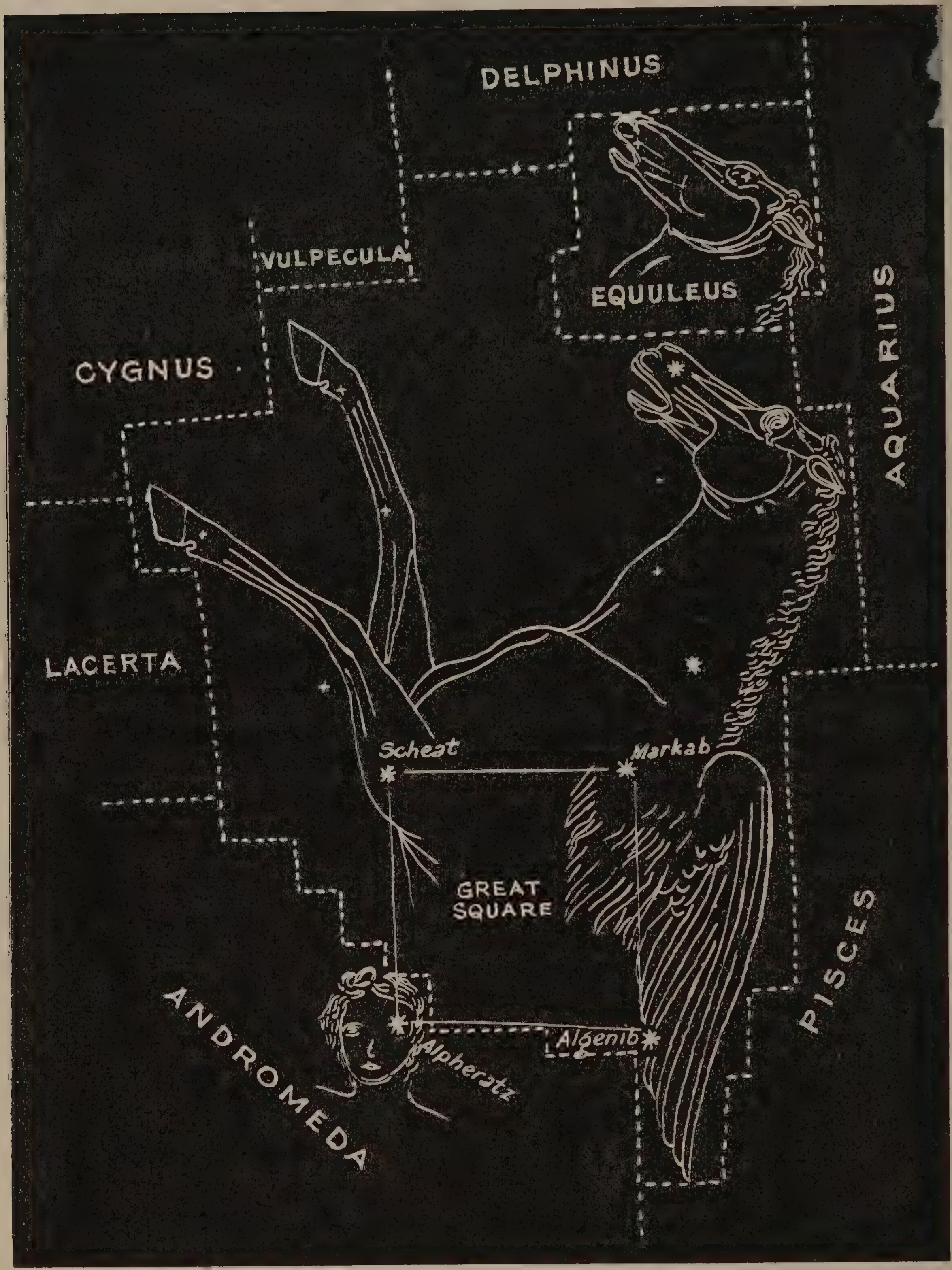
Mercury.—An evening object all this month. On the 1st, in the constellation of Libra, it will set about 1 hour after the sun and will reach greatest angle east of the sun on the 28th, when in the constellation of Ophiuchus it will set about 1¾ hours after sunset.

Venus.—Now rising about 2¼ hours before the sun and is situated in the constellation of Leo at the beginning of November and in the constellation of Virgo at the end of the month. On the 21st it will pass close to Saturn.

Mars.—Also a morning object in the constellation of Leo and is situated farther from the sun than Venus or Saturn. On the 1st it will rise about 2½ hours before the sun and at the end of the month will rise 3¼ hours before sunrise.

Jupiter.—A brilliant evening object, situated in the constellation of Pisces. At the beginning of the month it will set between 3.32 a.m. and 4.45 a.m. and at the end of November will set soon after midnight.

Saturn.—Placed near Mars and Venus, in the early morning eastern sky. On the 1st it will rise 1½ hours before the sun and will then be situated nearest the horizon. At the end of the month it will rise about 2 hours before the sun and will be placed between Mars and Venus.



THE CONSTELLATIONS.

An easily identified constellation, now appearing in the northern sky during early evening, is Pegasus—the Winged Horse. It is recognised by the four bright stars which form a square from which it also gets the name "The Great Square of Pegasus." However, only 3 stars of the square belong to Pegasus—Markab (Alpha), Scheat (Beta) and Algenib (Gamma). The fourth, Alpheratz, is now known as Alpha Andromedal but in some ancient star maps it was marked as delta Pegasi. The group is said by some to be named after the immortal steed of Perseus; another legend says that Pegasus was made by Neptune from the drop of blood which dripped into the sea from the Gorgon Medusa's severed head. Scheat (Beta) is a giant star about 87 times the diameter of our sun and is an irregular variable.

Between Pegasus and Aquila (described last month) are the constellations of Equuleus and Delphinus. Equuleus—the Little Horse—is a small inconspicuous group, but Delphinus—the Dolphin—is a small but beautiful group which is somewhat similar to the Pleiades to the naked eye, though not so bright. It is also known by the unromantic name of Job's Coffin.

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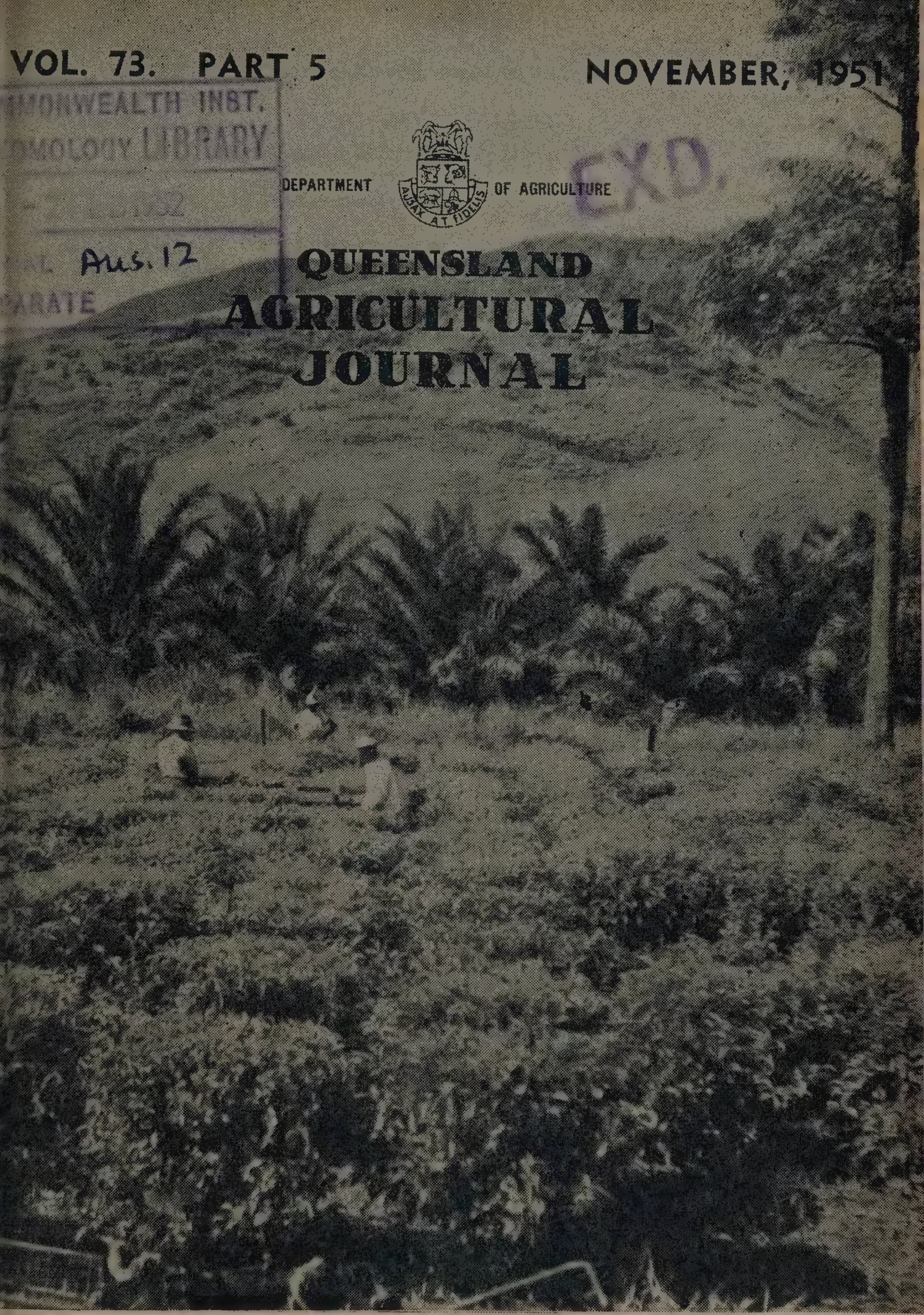
DEPARTMENT OF AGRICULTURE

QUEENSLAND AGRICULTURAL JOURNAL



Mechanical Tea Harvesting Trials, Bureau of Tropical Agriculture.

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GOVERNMENT PRINTER, BRISBANE

9

Contents

Bush Hay Conservation in North-Western Queensland.

S. MARRIOTT (Agrostologist, Agriculture Branch) and J. HARVEY (Senior Chemist, Biochemical Section).

IT has long been the policy of the Department of Agriculture and Stock to advocate fodder conservation methods wherever practicable as a means of minimising stock losses from drought. Usually it is considered that fodder conservation is uneconomic in the lower rainfall zones where cultivation is not practicable. However, in view of the high prices now being received for wool and beef, and the consequent appreciation in the value of livestock, it is more important than ever to consider the practicability of conserving feed, even surplus grass in the form of bush hay.

Of considerable interest to all stock owners is a project involving conservation of bush hay which has been started by Mr. D. M. Collings, of Colwell Station, McKinlay, in north-western Queensland, to whom due acknowledgment is made for permission to publish much of the data contained in this article. The property has an annual rainfall average of approximately 15 inches.

Equipment for Bush Hay Conservation.

A complete outfit of harvesting machinery is used on Colwell Station. The plant includes:—

One 40 h.p. crawler type tractor;

One Ferguson tractor;

Three 6-feet horse-drawn type mowers;

Two 9-feet side delivery rakes;

One self-tying pick-up baler.

In order to increase efficiency and reduce running costs, a special multiple tractor hitch of tubular steel was made, enabling several machines to be drawn simultaneously. The three mowers are fixed in echelon on the right-hand side of the large tractor, and the two rakes, delivering to a central windrow, are on the left (Plate 136). Where the crop is lighter than the one cut, the number of mowers and rakes could probably be increased.

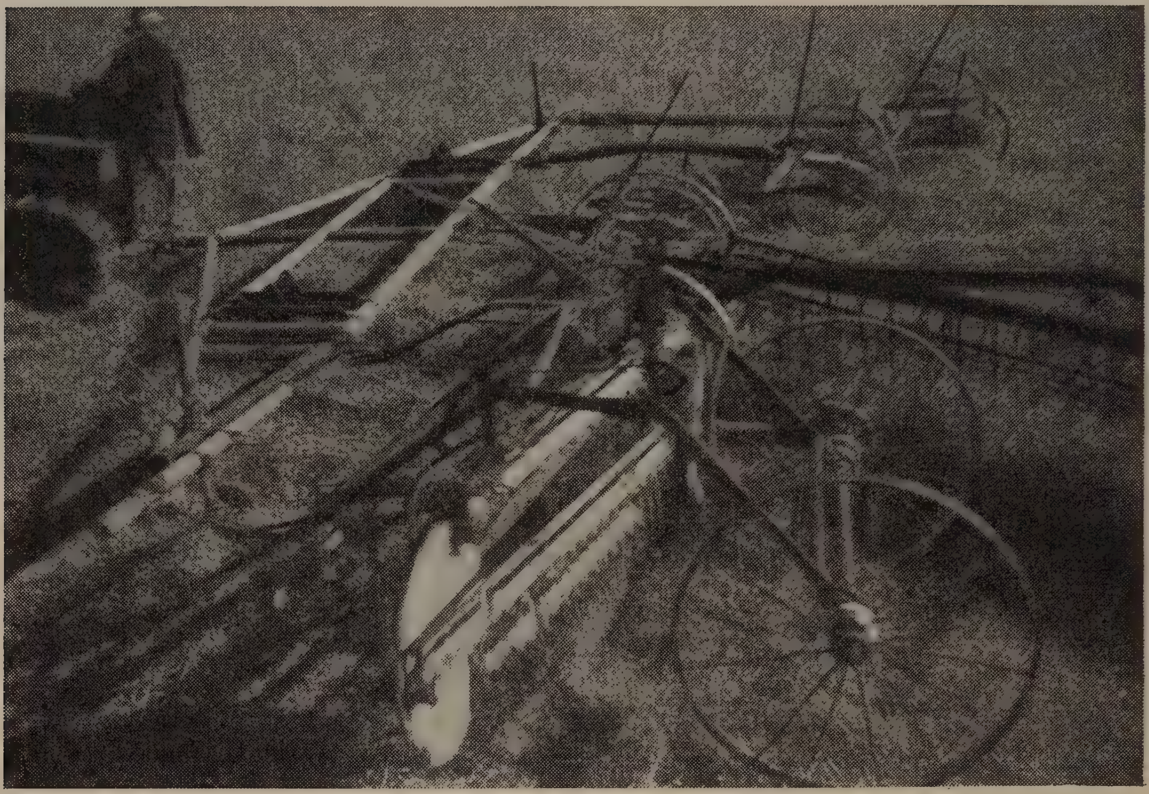

Plate 136.

Showing Hitch for Mowers and Rakes as used at Colwell Station, McKinlay.

With this arrangement and with only the tractor driver necessary, an 18 feet wide swathe can be cut on each round and the hay cut on the previous round simultaneously raked into one windrow (Plate 137). In terms of horse-drawn mowers and rakes, it is estimated that the tractor and driver have replaced at least eight horses and five men.

Plate 137.

Mowing and Raking Bush Hay at Colwell Station, McKinlay.

The pick-up baler follows immediately behind the rakes (Plate 138). It has been found that in a crop averaging 14 cwt. of cut hay per acre, a mowing and raking speed of 3 m.p.h. is just sufficient to keep the baler in work.

Plate 138.

Ferguson Tractor and New Holland Baler Baling Bush Hay at Colwell Station, McKinlay.

Plate 139.

Baled Bush Hay being Loaded for Carting from the Field to the Stack, Colwell Station, McKinlay.

Bale size has averaged 36 in. x 18 in. x 15 in., with approximate weight per bale on delivery 80 lb. However, changes in weight of bales due to moisture loss on standing in the field have been considerable. Weight on stacking was reduced to 65 lb. or less after lying for three weeks in the field. Even after two days, loss was considerable.

Plate 140.

Building a Stack of Baled Bush Hay at Colwell Station, McKinlay.

Plate 141.

A Stack of Baled Bush Hay Built at Colwell Station, McKinlay.

Plate 142.

A Stack of Bush Hay Covered with Loose Hay for Protection, Colwell Station, McKinlay.

During 1950, Colwell Station was able to cut, bale and stack about 10,000 bales of hay in approximately 77 working hours. The working time was spread over 28 days and the average baling rate was approximately 129 bales per hour. As the baling machine used is capable of delivering 200 bales per hour, it is possible that harvesting rates could be speeded up.

One of the chief factors in reducing the speed of baling on large areas of country was the mechanical obstructions to the mowers resulting from the tussocky nature of the grasses. Mitchell grass (species of *Astrebla*) plants may have their butts encased in soil up to a height of six inches and mowing on such country is slower than mowing on smoother areas carrying mainly Flinders grass (species of *Iseilema*) and button grass (species of *Dactyloctenium*).

Feed Value.

Of major importance in any such fodder conservation scheme is the nutritive value of the conserved hay. The initial food value will depend on the pasture species used and the stage at which they are harvested. A sample of the mixed Mitchell and Flinders grass hay was submitted shortly after harvest for analysis and for palatability and digestibility trials with sheep. The results are listed in the Table 1, in which the analysis is compared with analyses for fair average Sudan grass hay and fair average Rhodes grass hay.

TABLE 1.

RESULTS OF ANALYSIS OF MITCHELL–FLINDERS GRASS HAY COMPARED WITH SUDAN AND RHODES GRASS HAYS.

—	Digestible Nutrients.	Composition by Analysis. (Water-free Basis).		
	Mitchell-Flinders Grass Hay.	Mitchell-Flinders Grass Hay.	Fair Sudan Grass Hay.	Fair Rhodes Grass Hay.
	%	%	%	%
Crude protein ..	2·2	5·6	6·5	4·9
True protein ..	1·6	4·0	..	..
Crude fat	0·9	1·2	1·0	0·9
Fibre	19·3	35·8	35·5	35·1
Ash	..	11·9	10·5	10·5
Carbohydrate ..	26·0	45·5	46·5	48·6
Lime (CaO).. ..	..	0·60	0·60	0·63
Phosphoric Acid (P_2O_5)	..	0·16	0·40	0·53

The gross digestible energy of the Mitchell-Flinders grass hay expressed in terms of starch is 45·8 per 100 lb., compared with calculated values of 45 for fair Sudan grass hay and 43 for fair Rhodes grass hay. From this initial feeding trial the following conclusions were drawn:—

(1) The baled hay, as received shortly after harvest, was readily palatable to sheep.

(2) In spite of the high fibre content, the hay was well utilised by sheep—that is, the percentages of the nutrients which were digested by the sheep were high.

(3) The total protein content in the hay was low. It is doubtful if this level would meet the maintenance requirements of the sheep.

(4) The level of phosphoric acid was below maintenance requirements.

It would appear, therefore, that pasture hay of the quality represented by this sample, which was tested shortly after harvest, would need supplementation with protein to provide a satisfactory ration. Most protein supplements are also rich in phosphate and their use would correct the deficiency of this material as shown in the analysis. Button grass is known from previous analytical work to be of higher quality than Mitchell grass. For this reason, it is anticipated that hay made from the Flinders and button grass mixtures would be more valuable fodder than hay containing large amounts of Mitchell grass.

Bush Hay Storage.

It must be remembered that considerable deterioration in value will follow on lengthy storage of pasture hay in dry areas. This deterioration not only involves loss of weight through drying out; actual changes in composition also occur due to slow oxidation, together with very real losses in vitamin content.

These losses may be minimised by reducing air circulation within stacks, and by protecting the stack from weather. Provision of permanent weather-proof shelters may be uneconomic for hay of relatively low feed value, but, if stacking is done efficiently following closely on cutting and baling, the initial deterioration can be reduced considerably. The bales should be as tightly compressed as possible.

Protection from heat and rain by rough thatching with loose hay or brush will assist materially in conserving the quality of the hay. Where procurable at low cost, malthoid types of sheeting laid over an insulating layer of loose hay on the top of the stacks to extend well down the sides will form a weather-proof shelter. Such a covering is readily secured with poles, wires and weights.

Where labour shortage is overcome by mechanical hoists and loaders, and where stack sites are permanent, the use of weathered outside bales from the original stacks as outside bales for the new season's hay would reduce deterioration of the fresh fodder, and these old bales could be utilised at little cost. In order to determine the rate at which this deterioration takes place under field conditions, arrangements have been made to analyse and test samples taken from the stacks at Colwell at regular intervals.

Management of Hay Pastures.

The possibility that mowing the same area in successive years may affect the botanical composition of the pastures must not be overlooked. Any treatment which prevents the seeding of annual grasses or herbage for a number of years would be expected to reduce their population in the pasture.

If areas suitable for mowing are relatively restricted, and if repeated mowing is having an effect on pasture composition, the effective reseeding may be accomplished by leaving small islands or strips of unmown pasture at right angles to the wind direction prevailing at seeding time to act as seed reservoirs.

It is also possible that cultural treatment aimed at smoothing out the rough areas may cause changes in pasture composition which may or may not be beneficial. For instance, it is known that Flinders grass seed is capable of lying dormant in the soil for many years. Cultivation of virgin grassland on the Department's Wrotham Park Exploratory Farm, 55 miles north-west of Chillagoe, resulted in very marked increases in the Flinders grass population. These pastures were originally dominated by a blue grass (*Dichanthium fecundum*) and carried only about 10 per cent. of Flinders grass, but following one cultivation, virtually pure stands of Flinders grass appeared with the corresponding disappearance, at least temporarily, of the blue grass. It is not yet known whether or not this change in pastures at Wrotham Park is beneficial to the grazing animal.

Similar prolific growth of Flinders grass has been reported in good seasons from other widely scattered areas in Queensland, following disturbance of the soil by cultivating implements, though in these cases it is understood that deteriorated pastures were implicated.

The fact that such changes do occur emphasises the importance of understanding and controlling such population changes before large areas of virgin country are disturbed. Work being undertaken on the Wrotham Park Exploratory Farm is designed to study this problem.

Summary.

As a result of work in 1949-50, Colwell Station accumulated a drought reserve of 10,000 bales of bush hay, which under test proved palatable to sheep. The analyses indicated that some complementary feeding would be necessary and there is field evidence to show that such feeding is essential if flock fertility is to be maintained and improved. Though the protein and phosphorus levels were low, the hay conserved could be assumed to be at least equal in quality to standing hay at the end of the dry season and defininitely superior to the stubble remaining in the field during prolonged dry weather.

TUBERCULOSIS-FREE CATTLE HERDS.

(AS AT 22nd OCTOBER, 1951.)

Breed.	Owner's Name and Address of Stud.
Aberdeen Angus ..	The Scottish Australian Company Ltd., Texas Station, Texas
	F. H. Hutton, "Bingegang," Dingo
A.I.S...	F. B. Sullivan, "Fermanagh," Pittsworth
	D. Sullivan, "Bantry" Stud, Rossvale, *via* Pittsworth
	W. Henschell, "Yarranvale," Yarranlea
	Con. O'Sullivan, "Navillus Stud," Greenmount
	H. V. Littleton, "Wongalea Stud," Hillview, Crow's Nest
	J. Phillips and Sons, "Sunny View," Kingaroy
	Sullivan Bros. "Valera" Stud, Pittsworth
	Reushle Bros., "Reubydale" Stud, Ravensbourne
	H. F. Marquardt, "Chelmer," Wondai
	W. G. Marquardt, "Springlands," Wondai
	A. C. and C. R. Marquardt, "Cedar Valley," Wondai
	A. H. Sokoll, "Chelmsford," Wondai
Ayrshire	L. Holmes, "Benbecula," Yarranlea
	J. N. Scott, "Auchen Eden," Camp Mountain
	"St. Christopher's and Iona" Studs, Brookfield Road, Brisbane
Friesian	C. H. Naumann, "Yarrabine Stud," Yarraman
	J. F. Dudley, "Pasadena," Maleny
Guernsey	C. D. Holmes, "Springview," Yarraman
Jersey	W. E. O. Meier, "Kingsford Stud," Rosevale, *via* Rosewood
	J. S. McCarthy, "Glen Erin Jersey Stud," Greenmount
	J. F. Lau, "Rosallen Jersey Stud," Goombungee
	G. Harley, Hopewell, Childers
	Toowoomba Mental Hospital, Willowburn
	Farm Home for Boys, Westbrook
	F. J. Cox and Sons, "Rosel" Stud, Crawford, Kingaroy Line
	R. J. Browne, Hill 60, Yangan
	P. J. L. Bygrave, "The Craigan Farm," Aspley
	A. Verrall and Sons, "Coleburn Stud," Walloon
	R. J. Crawford, "Inverlaw Jersey Stud," Inverlaw, Kingaroy
	P. H. F. Gregory, "Carlton," Rosevale, *via* Rosewood
	E. A. Matthews, "Yarradale," Yarraman
	A. L. Semgreen, "Tecoma," Coolabunia
	G. & V. Beattie, "Beauvern," Antigua, Maryborough
	L. E. Meier, "Ardath" Stud, Boonah
	A. M. and L. J. Noone, "Winbirra," Stud, Mt. Esk Pocket, Esk

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The Grape.*

M. A. HANNIGAN, Senior Adviser in Horticulture.

THE grape vine is one of the oldest cultivated plants. It was well established in Persia, Syria and some Asiatic countries more than 5,000 years ago and spread westward with the advance of civilization. The Greeks and Romans gave special attention to the crop, which had a recognised place in public festivals. In France, Italy, Spain and Portugal, and the southern portions of Germany, viticulture has been a source of great wealth for a very long time.

To-day, the grape is a commercial crop in every country where the climate permits its cultivation. In the northern hemisphere, it is grown within the latitudes of 25 and 45 degrees, while south of the equator it is cultivated between the latitudes of 20 and 40 degrees.

The grape vine has been cultivated in Queensland for a considerable period and great progress has been made during the past 30 years. The present area under crop is 3,135 acres, but there is almost unlimited land available for any expansion that may occur.

Grapes are grown commercially in Queensland in the Stanthorpe, Roma, Charters Towers, Rockhampton, Metropolitan (Brisbane), Lockyer and Yelarbon districts. Practically all of the fruit is sold for table use, though a small quantity of the Stanthorpe and Roma crop is used for wine making. The industry has an average annual production of approximately 230,000 half-bushel cases. The Stanthorpe district produces about 80 per cent. of the Queensland crop and the main harvesting period is from February to March. Grapes from the other districts mature earlier and are marketed from early December to the end of January.

In the Charters Towers, Rockhampton and Yelarbon districts, where prolonged dry periods occur in the spring and early summer months, grapes are grown under irrigation, whereas at Stanthorpe the vines are wholly dependent on an annual rainfall of approximately 30 inches.

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* This article is a revision of an advisory pamphlet written by the late Mr. F. A. L. Jardine and published in the *Queensland Agricultural Journal* in February, 1939.

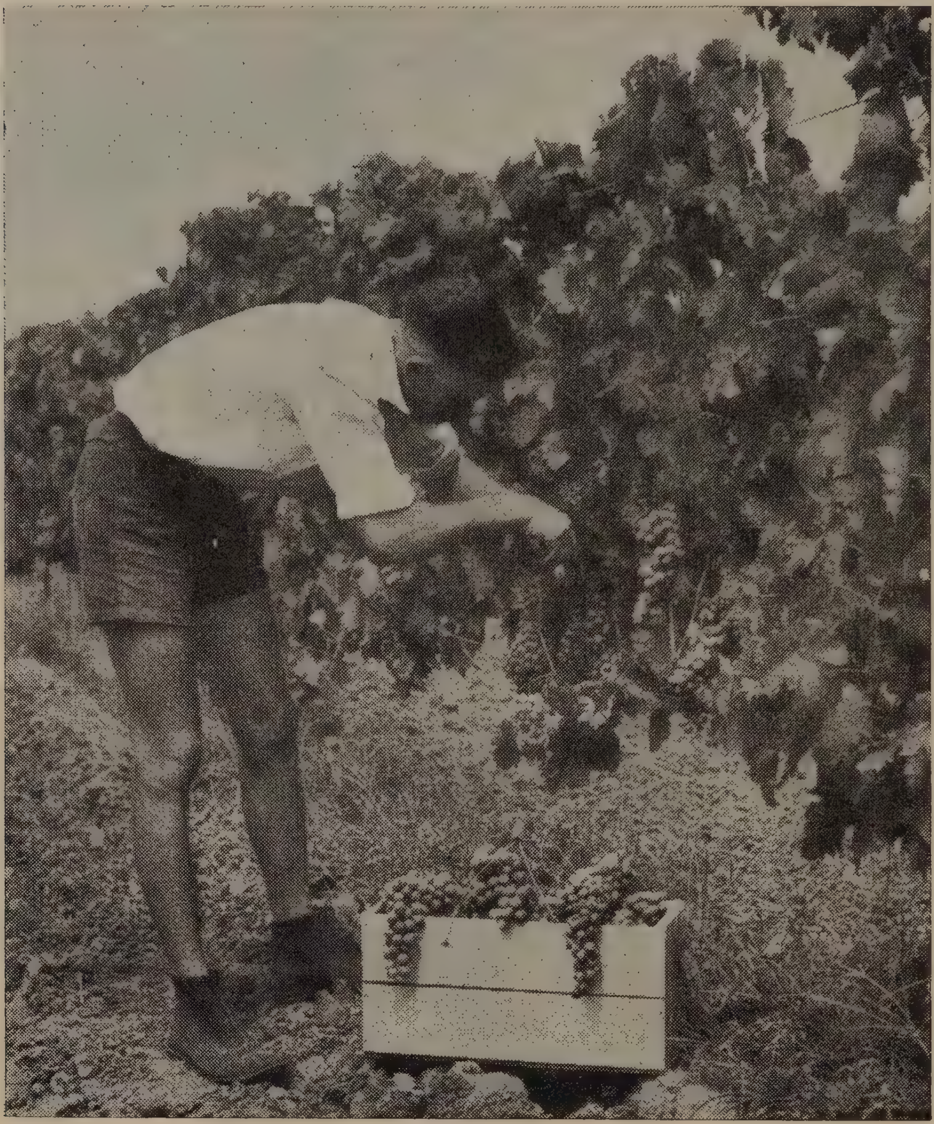


Plate 143.
Grapes in Central Queensland.

SPECIES AND VARIETIES.

The grape vine belongs to the family *Vitaceae* and all the European varieties are included in the species *Vitis vinifera.* The American vines are also of some importance and the several species are native to the American continent.

European vines are far more widely grown than the American vines. They include a great number of varieties suitable for the fresh fruit, dried fruit (raisin) and wine trades. All thrive in the dry districts where winter temperatures are comparatively low. They do not, as a rule, flourish near the coast and commercial production in these areas is somewhat hazardous.

American vines can be recognised by (*a*) vigorous canes with widely spaced nodes; (*b*) leaves which are felted on the undersurface, not deeply lobed and free from pronounced serrations; and (*c*) fruit with a gelatinous flesh, a foxy flavour and a rather tight skin. Some American varieties of the Labrusca type, such as Iona, are cultivated for dessert use and occasionally for wine making. However, the fruit is generally inferior to that of the European varieties, and the wine produced from them is not of good quality. They thrive best in humid districts.

Many American vines and their hybrids are resistant to the Phylloxera aphid and they provide a good rooting system for European vines which, if grown on their own roots, would soon die in areas infested by this insect.

The climate of Queensland is unsuitable for many grape varieties and only a limited number crop well and produce fruit acceptable on the markets. Untested varieties should be planted only on a small scale for trial purposes. The following list of European varieties grown in Queensland is arranged in the order of their suitability for the district.

Early.	*Mid-season.*	*Late.*
	COAST SOUTH FROM ROCKHAMPTON.	
Chaouch	Muscat Hamburg	
Madelleine Royal	Black Hamburg	
Ferdinand de Lesseps	Royal Ascot	
	NORTH OF ROCKHAMPTON.	
White Wax	Royal Ascot	Servant
Chaouch	Muscat Hamburg	
Madelleine Royal	Black Hamburg	
Ferdinand de Lesseps	Improved Isabella	
Goethe		
Wilder		
	STANTHORPE AND WESTERN HIGHLANDS.	
Chaouch	Muscat Hamburg	Waltham Cross
	Gros Colman	Purple Cornichon
		Servant

Many other varieties have been grown in the above districts. However, in commercial vineyards most of them have been or are gradually being "worked over" to the listed varieties, which are known to be suitable for conditions in Queensland. Characteristics of the more important varieties are:—

Chaouch.—A large, round, early grape with a melting flesh and a thin transparent skin. The bunches are of medium size. The vine has a strong and robust constitution and bears canes with long internodes and large woolly leaves. The habit of growth and appearance are distinct from those of other varieties and the shoots must be well tied-in as the attachment to the spur is weak. Harvested at Stanthorpe during February.

Muscat Hamburg.—A large, oval, black, mid-season grape with a thin skin, sweet flesh and a fine Muscat flavour. Large-shouldered, tapering bunches. The vine is a moderately vigorous grower and does remarkably well over a wide range of the State. In some districts, it is subject to the "hen-and-chicken" disorder. Probably the best of the Black Muscats. Harvested on the coast during December and January, and at Stanthorpe in February.

Gros Colman.—A very large, round, black, mid-season grape with firm flesh, a tough skin and fair flavour. The vine is vigorous and a prolific cropper but lack of berry colour is associated with overbearing. The fruit is particularly susceptible to grey mould. Harvested at Stanthorpe during March.

Waltham Cross.—A large, oval, late maturing grape. Very large berries with thick skin of greenish-yellow colour, changing to deeper amber when thoroughly ripe. The flesh is very firm, sweet and crackling, but not particularly rich in flavour. The bunches are large and tapering, with very long stalks. The vine is a shy bearer and should be long pruned. The variety is prone to anthracnose and "hen-and-chickens." Harvested at Stanthorpe during March.

Purple Cornichon.—A very large, elliptical-shaped berry of intense bluish-purple colour. The skin is thick and tough, and the flesh is brisk, pleasant, and crackling. The fruit ripens late and hangs well but the vine is a shy bearer and should be long pruned. The variety is prone to anthracnose. Harvested at Stanthorpe during March and April.

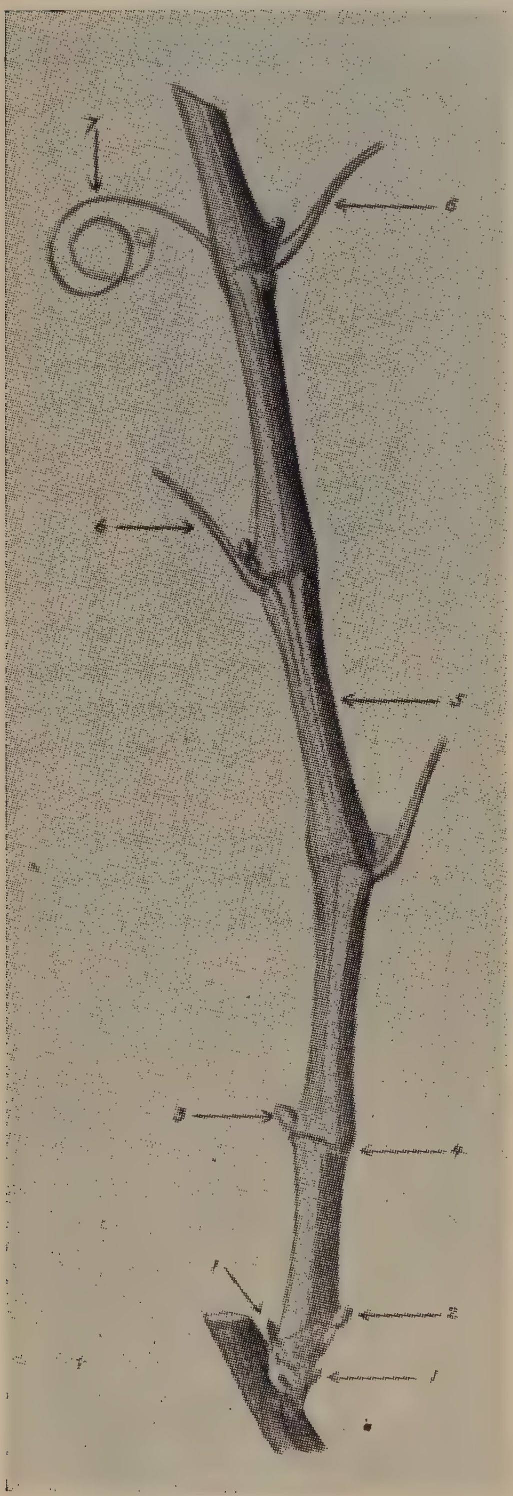


Plate 144.

Basal Part of Cane. 1, base bud; 2, first bud; 3, second bud; 4, node; 5, internode 6, leaf stalk; 7, tendril.

Servant.—A roundish-oval, greenish-white, late maturing grape. Berries large and relatively thick-skinned, with a pleasantly refreshing pulp. The vine is vigorous and very productive. Harvested at Stanthorpe during March and April.

STRUCTURE OF THE PLANT.

From the time of bud burst in the spring, growth proceeds rapidly until the fruit is approaching its full size though still green. At this stage, vegetative growth practically ceases and the vine nourishes the fruit to full maturity. From then on until leaf fall, food reserves are built up in the canes. The vine sheds its leaves in winter and remains dormant until spring.

The vine has three kinds of roots, the primary or main roots, secondary or lateral roots, and the smaller tertiary roots branching from the laterals. The growing tips of the roots are furnished with root hairs through which plant foods are absorbed from the soil.

The annual vegetative growth of the vine consists of pithy fruit bearing canes (Plate 144) and water shoots. Fruit bearing canes arise from the buds of the previous year's growth and produce the annual crop of fruit. Water shoots develop from the dormant buds on the older portions of the vine; they bear little or no fruit until the second year and are normally suppressed. They may, however, be retained to correct the effects of severe pruning or to reform injured or unprofitable vines.

The leaves of the grape vine are large and lobed; very few varieties have entire leaves and a five-lobed leaf is the most common type. The opening between the lobes is known as the sinus. The margin of the leaf is serrated, the serrations being either pointed or blunt.

The flowers are usually small, light green in colour and of three types—hermaphrodite, female and male. They are grouped in clusters, each of which is referred to botanically as a panicle. Hermaphrodite flowers are the more common type in most European varieties. They are self-pollinated and therefore capable of setting fruit without the aid of pollen from other flowers. Male and female flowers are more common amongst American vines.

Tendrils may be regarded as inflorescences which have failed to develop into bunches of fruit and occasionally bear odd berries or a small bunch of fruit. They attach themselves to the trellis and support the canes. Tendrils, like bunches, develop on the canes at the nodes and opposite the buds. They arise towards the ends of the canes, while the bunches appear nearer the base.

CLIMATIC REQUIREMENTS.

The grape vine is a deciduous plant and grows most satisfactorily when the winter is sufficiently severe to ensure a period of complete dormancy each year. The plant is capable of withstanding severe frosts when completely defoliated, though intense cold such as is experienced in Northern Europe can kill vines outright. The weather should be warm and comparatively dry when the fruit is ripening but excessive heat may scorch both the fruit and foliage, especially in varieties such as Muscat Hamburg which are subject to sunscald. Vines growing in areas with a heavy summer rainfall usually suffer from diseases and the fruit may lack sugar and full colour.

In Queensland the grape vine can be successfully grown in many districts. The southern portion of the State is considered the most suitable, especially inland on the Darling Downs and on the highlands to the west. The Stanthorpe district, known as the Granite Belt, is the chief producing centre for choice table grapes. The Roma district grows excellent table and wine varieties. Parts of far-western Queensland are capable of producing high quality berries, though in some of the drier areas irrigation is necessary. Fruit harvested in these inland districts has a high sugar content, a characteristic which is desirable for the production of raisins. The tablelands of northern Queensland grow a limited number of varieties, while some parts of central Queensland, west from Rockhampton, produce excellent grapes of the Muscat type.

Coastal districts with a relatively high humidity during the summer months are favourable for the development of diseases in grape vines, while a mild winter frequently causes an early budburst. However, in the areas adjacent to Brisbane, grapes are grown successfully on a limited scale. The varieties cultivated are chiefly the hardier American vines, but a few of the European varieties have proved satisfactory.

SOIL AND LOCATION.

The vine is a very accommodating plant and will adapt itself to a great variety of soils; good drainage, however, is essential. The plant will not tolerate wet situations or land that has an underlying hard-pan of impervious clay holding water about the roots. Soils of this

type should not be planted. Soils derived from granite are particularly suitable for the crop and generally speaking, fertile deep, loose, light to medium loams are preferable to the heavier loams. Clay loams in areas with a heavy rainfall are apt to produce over-vigorous vines which are susceptible to disease and sometimes bear soft fruit lacking both colour and sugar.

The site for the vineyard must be well drained, sheltered from strong winds and not subject to severe late frosts. In the cooler portions of Queensland, a warm situation is necessary in order that the fruit will mature satisfactorily. A northern or north-eastern slope receives most of the sun's rays and gentle hillside slopes of this type are preferred for the crop. In the warmer parts of the State, a southern, south-eastern or south-western aspect may be used.

The direction in which the vines are trellised is usually fixed by the slope of the land and the most economical method of establishing and working the vineyard. However, where the summer temperature is high, grapes are less exposed to sunburn where the rows run from east to west. When the land is contoured, the trellised rows follow the contour.

SOIL PREPARATION.

The preparation of the soil prior to planting must be thorough. In virgin soil, the land must first be carefully cleared of standing timber, brush and stumps, and all roots brought to the surface. When these have been burnt, the stump holes should be filled in and the land levelled off for the first ploughing. This having been completed, one or possibly two harrowings will be necessary and all stray roots and other debris can be gathered into heaps and burned. A cross ploughing can now be given, the depth being regulated so that none of the subsoil is brought to the surface. After cross ploughing, the land is worked down to a medium tilth and is then fallowed for some weeks before the final ploughing. If the subsoil is clayey, subsoiling should be carried out at the same time as the final ploughing, the subsoil plough following directly in the furrow made by a single furrow mouldboard or disc plough. If it is not practicable to subsoil the whole vineyard, every effort should be made to treat the trellised row. Subsoiling tends to produce a deep rooted vine which is better equipped to withstand the extra strain imposed upon it in dry periods. The land at this stage can be pegged out in readiness for planting in late winter.

PLANTING.

The vineyard may be established in late winter by planting cuttings (Plate 145) directly into their permanent places or by planting rooted cuttings. The first method is quite satisfactory on new land which has been recently cleared and well-prepared. However, when the land has been previously under crops and weeds are liable to be a problem, rooted cuttings should be used.

When planting unrooted cuttings in moist soil, a bar is sunk to a depth sufficient to take the cutting, which is then placed in the hole with one bud about ground level and one bud above the ground. The bar is again inserted into the ground an inch or two from the cutting, this time at an angle, and the soil is then forced towards the cutting in

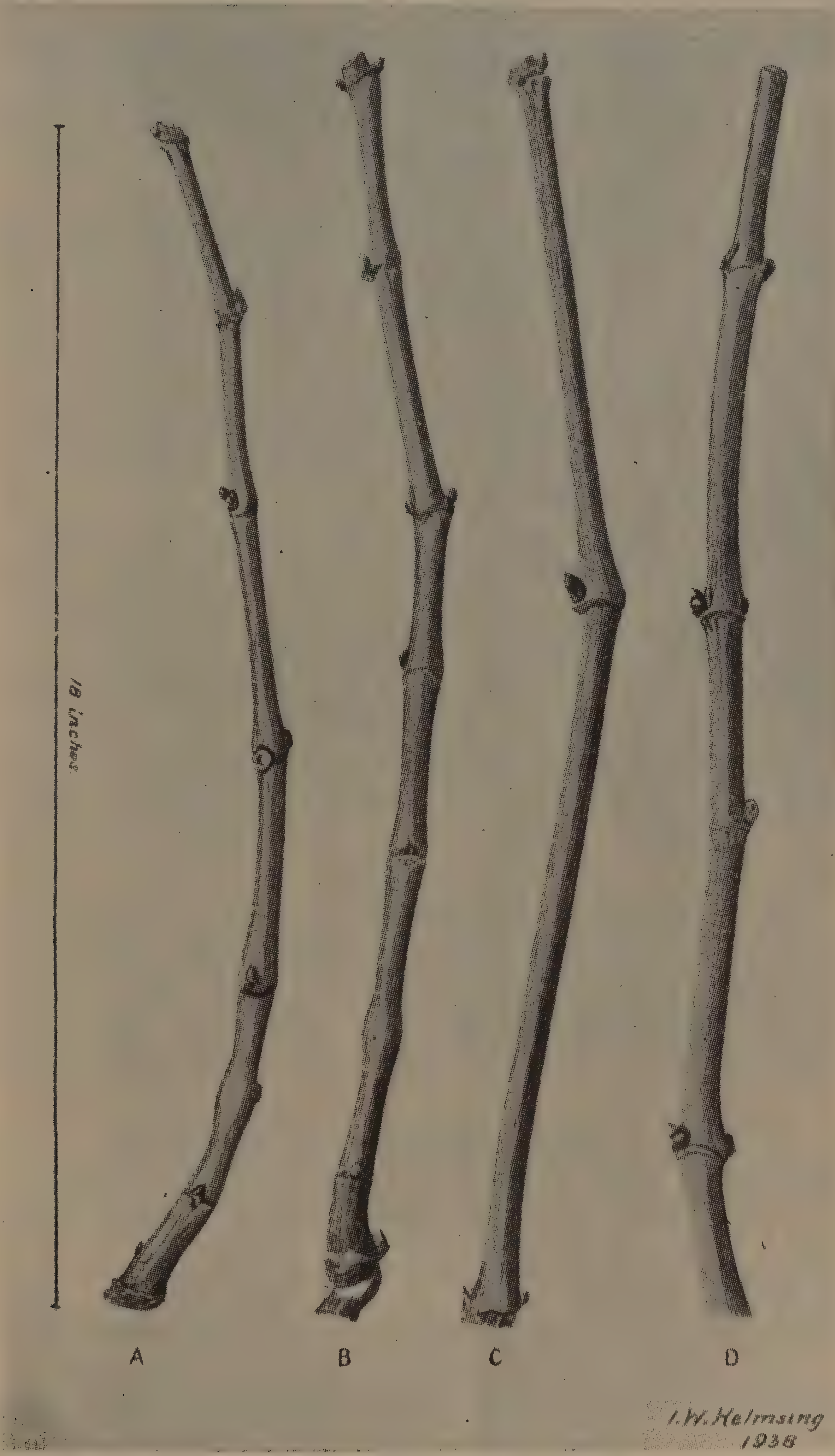


Plate 145.

Cuttings for Propagation. A and B, good cuttings with short internodes; C, bad cutting with long internodes; D, cutting badly trimmed (the cut should be at the node).

such a manner as to seal it completely from the base up. The second hole made by the bar can be filled in by tramping. When planting in dry land, the cuttings are watered in. The cutting is placed in the hole made by the bar; the hole is then filled with water and then firmly closed by hand after the water has soaked away. It is a common practice to set two cuttings at each peg; should both strike, one is removed and may be used as a replacement.

Rooted cuttings are lifted carefully from the nursery when about 12 months old, covered with a damp sack and planted as soon as possible. The roots should be neatly trimmed, long roots being shortened back and those arising about ground level completely removed. The most upright growing cane is cut back to two buds and the rest of the canes are completely removed. The young vine is planted at the same depth as it was growing in the nursery. The roots should be evenly spaced, and when filling in the hole the soil must be well tramped about them. Should the land be dry, water can be placed in the bottom of the hole before planting, or, better still, added when the hole has been about two-thirds refilled with soil.

The distance apart at which the vines may be planted depends upon the class of soil and the rainfall. In the dry inland areas, European vines grown on the trellis system can be planted at from five to eight feet apart in the row and usually 10 feet between the rows, while if grown as bush vines they should be planted on the square six to eight feet apart. Where there is a good rainfall and the soil is heavier, the vines can be planted more closely.

American vines are always grown on a trellis. Being stronger growers than European vines, they require to be planted 10 to 12 feet apart in the rows.

PROPAGATION.

The cuttings used to establish a new vineyard are obtained from the canes of the previous season. The sturdiest and most reliable cuttings are taken from the lower part of the mature canes adjoining the old wood. Short-jointed canes should be selected where the source of supply is large enough to permit it. The vines from which cuttings are taken should be vigorous, free from disease and possess a good cropping record.

Cuttings should be made as soon after pruning as possible. When preparing a cutting, the cane is severed with a sharp knife or secateurs directly below a node and again just above a node about 15 to 18 inches further up the cane. Clean cuts enable a callus to quickly form over the cut surface. The cuttings are placed in bunches of 50 to 60 and buried under at least six inches of soil, or, alternatively, heeled in at an angle leaving three to four inches showing above the ground. Cuttings keep best in a cool, shaded sandy soil that is damp but not wet.

New land should be used in the nursery for rooting the cuttings. The soil should first be worked to a fine tilth by repeated ploughings and harrowings. The nursery rows may be made by ploughing deep furrows in which the cuttings are set three to four inches apart and at an angle of 45 degrees to ground level. The furrows are then filled

in and the soil well firmed, leaving two buds out of the ground, the bottom one at about ground level. If the soil is very dry, the cuttings should be watered before the furrow is completely filled in.

TRELLISING.

The trellis should be well constructed with posts of durable hardwood and plain galvanised fencing wire. The ordinary post and wire fence is usually used for trellising vines, the wires being either run through the posts or attached to them by a light galvanised wire; the former method is by far the more satisfactory.

The straining posts at the end of the rows should be at least eight inches in diameter, 30 inches in the ground and four feet above the ground; 5 in. x 4 in. intermediate posts are spaced 18 feet apart and well rammed into the ground to a depth of 18 inches or more. The straining posts must be stayed to keep them upright. The stay can be set into the ground by butting it against the first intermediate trellis post (which is nine feet from the strainer post) about eight inches below the surface of the soil; the uppermost end of the stay is let into the straining post midway between the second and top wires.

The first wire is set at a height of 20 inches from the ground and should pass through the end post to connect with a wire strainer by means of which the bottom wire is tightened when necessary. The second wire is 12 inches from the bottom one and the top wire 12 inches from the second. As the middle and top two wires merely support the annual cane growth of the vines, there is no need to attach them to strainers. The bottom wire, however, bears the weight of the vines and the fruit, and consequently must be kept taut in order to prevent sagging.

GRAFTING.

Cuttings are best grafted in late winter (that is, during August at Stanthorpe) about a month before they are required for planting out. Field grafting and bench grafting of young rooted vines are performed in the spring (that is, during September at Stanthorpe). The whip-tongue graft and the cleft graft are the two best known methods.

The Whip-tongue Graft.

The whip-tongue graft (Plate 146) is applied chiefly to young phylloxera-resistant vines and cuttings, the stock and scion, of the same diameter, being spliced together.

After being grafted, cuttings should be stratified by burying them horizontally in a moist sandy soil. A layer of grafts about two inches deep is placed in the bottom of the trench and covered with a thin layer of moist sandy soil. Another layer of grafts is placed in position and scattered with soil, and so on. When the trench is filled, it can be covered with soil to a depth of six inches. At the end of the winter, knitting tissue will have formed and the grafts can be carefully lifted and planted out with the union just below the surface. Soil is hilled to about one-quarter of an inch above the top bud of each plant to prevent the scion from becoming too dry.

Rooted cuttings of resistant vines can be bench-grafted after they are lifted from the nursery and before they are set in their permanent positions in the vineyard, or they may be grafted in the vineyard if the cuttings were originally planted there. In the former case, the grafted vine should be planted with as little delay as possible and immediately mounded up to the top of the scion. When grafting is done in the vineyard, each plant should be mounded immediately after

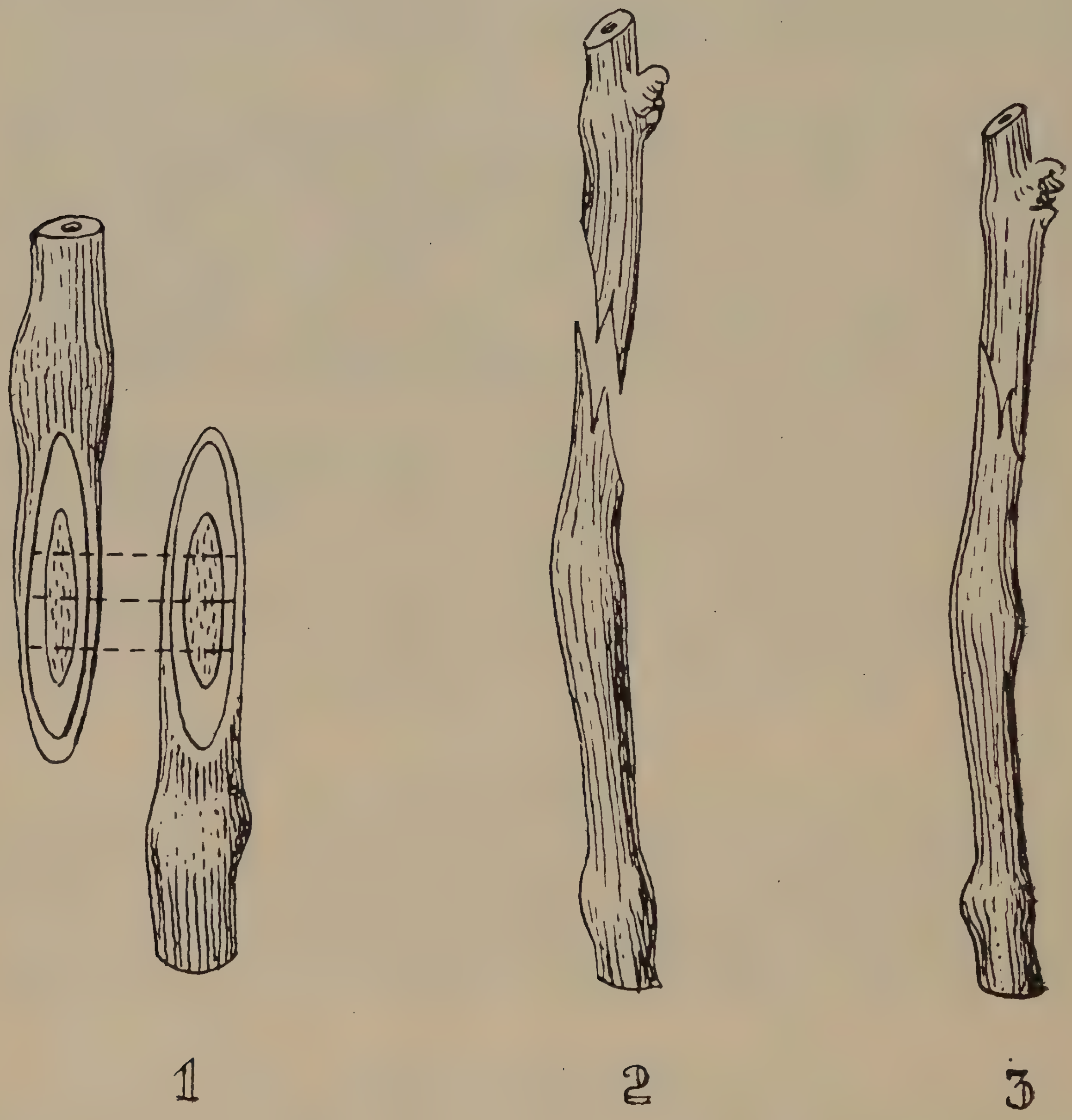


Plate 146.

Whip-tongue Graft. 1, section of stock and scion; 2, prepared stock and scion with tongues open; 3, graft united and ready for tying.

the graft is made. The grafts should be examined occasionally and any suckers or scion roots carefully removed. After each inspection, the grafts must be remounded but not necessarily to the same height. Great care is necessary to avoid damaging or displacing the grafts. By the time the union is complete, the raffia binding has usually rotted away. It is as well, however, to inspect a few vines occasionally to be quite sure that the binding is loose; otherwise the unions may choke.

The Cleft Graft.

Unlike the whip-tongue graft, the cleft graft (Plate 147) can be used on stocks of varying dimensions, from cuttings up to aged vines. However, vines up to eight years old graft more successfully and form better unions than older plants. Aged vines with large trunks can be grafted with two scions, but portion of the stock may die back before the grafts can cover the saw cut and the vine is then forced into an early decline. Cleft grafting is best performed in the early spring. The cuttings for grafting are kept in the same manner as those required for planting.

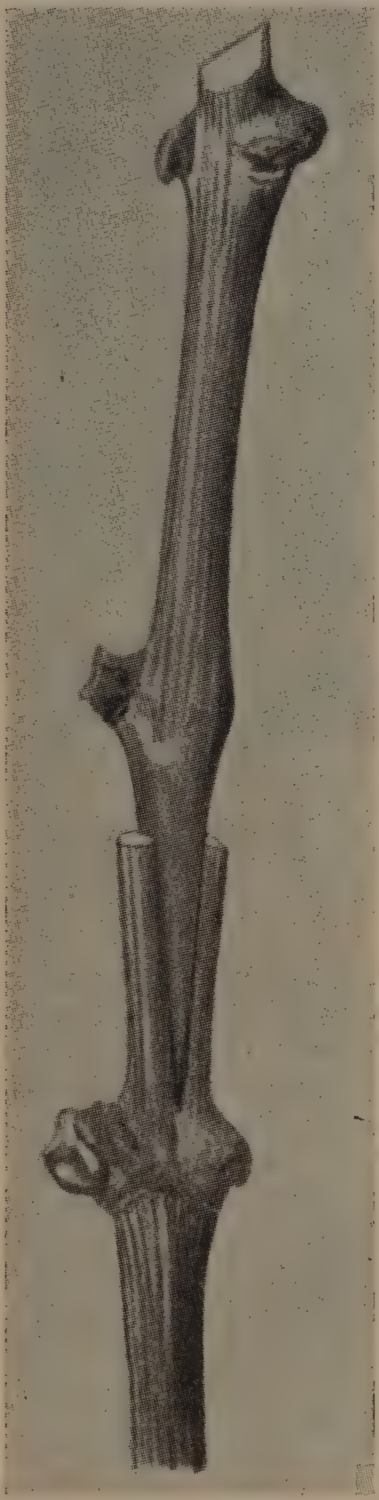


Plate 147.

Cleft Graft. This type of graft can be used for cuttings on cuttings, for cuttings on rooted stocks, or for reworking vines up to eight years old.

Top Graft.

In the case of large vines with a diameter between $1\frac{3}{4}$ and $2\frac{1}{2}$ inches at ground level, top grafting is the most satisfactory method. The vines are sawn off just below the bottom trellis wire in midwinter (June or July) in preparation for grafting, which is carried out during September.

After the two scions are inserted, the wedge section of the graft where the outer bark of stock and scion comes in contact is sealed over with grafting wax. The cuts on the top ends of the scions are also sealed, while the opening of the split on the stock between the scions is plugged with wax. Paper of double thickness is wrapped round the graft and tied about the base, the cup thus formed being filled with loose soil and slightly firmed down, leaving the top buds of the scions exposed.

After-care of Grafts.

The after-care of the grafts consists of keeping the knife cuts on the stock open to permit the escape of sap until the flow has finally subsided and suppressing any growth which arises from dormant eyes on the trunk of the vines. It may be necessary to completely remove some of the shoots on the stock and to pinch back others. This has the effect of diverting the sap flow to the scion buds and forcing them into growth.

When the scion canes have made 15-18 inches of growth, all the shoots on the stock are completely removed. The scion canes then make rapid headway and a strong callus is formed at the union of the graft. It is also necessary to make a periodical inspection of vines exuding an excessive quantity of sap so that any congealed sap lodged about the union can be removed, the paper being replaced and filled with fresh soil.

REPLACING MISSING VINES.

The propagation of grape vines by layering (Plate 148) is the practice usually adopted to fill up vacant spaces in the trellised row. After the second year from planting, the replacing of missing vines becomes increasingly difficult and replacements made with cuttings or rooted vines are usually dwarfed and unprofitable. Gaps in the row can, however, be successfully filled by layering a cane from an adjacent vine.

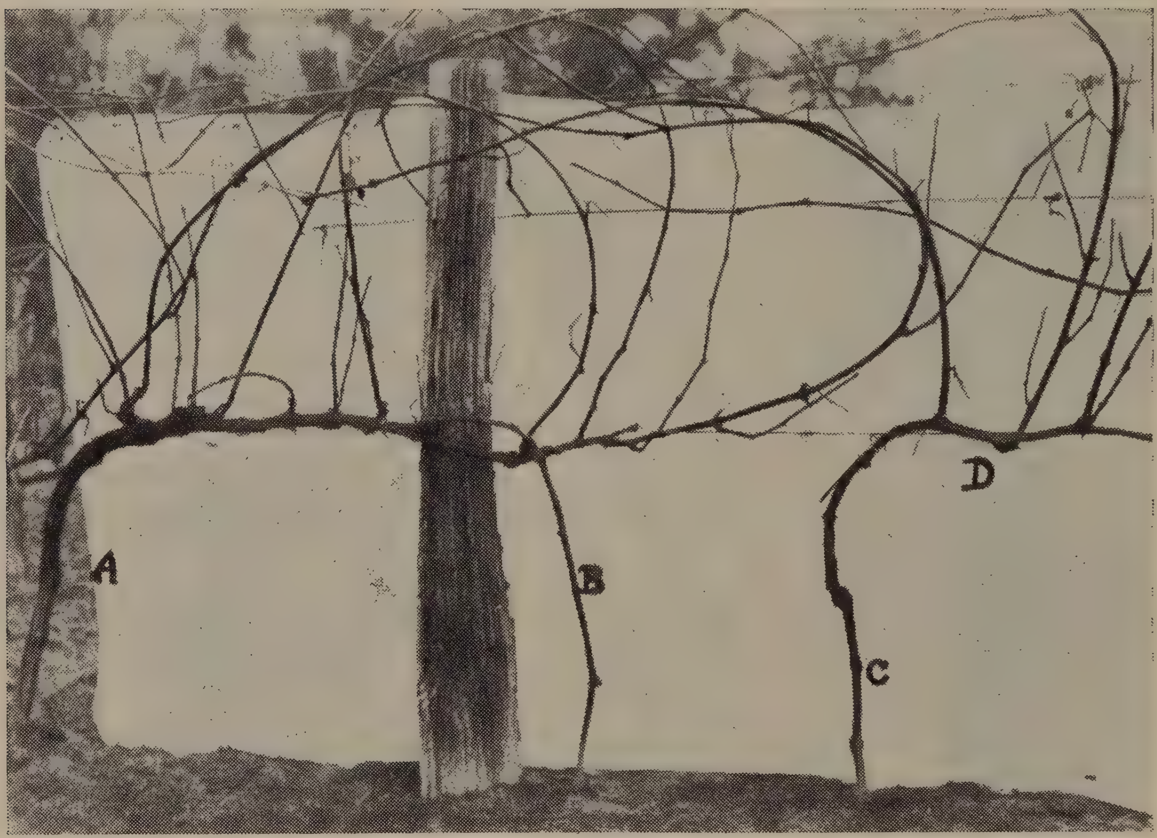


Plate 148.

Replacing Missing Vines. A cane (B) from the parent vine (A) is buried deeply with the tip above ground. The buried portion roots and produces the new vine (C and D) in the required position.

A strong cane of the previous year's growth from a neighbouring vine is bent over and buried where the plant is required in a trench 8-15 inches deep according to the class of the land. The end of the cane is allowed to protrude above the surface with a sharp bend, leaving two buds out of the ground. The following summer that portion of the cane in the ground develops roots and new shoots appear at the end above the ground. During the growing season, all growth from the layered cane between the point where it leaves the mother vine and where it enters the ground is removed. After the second season, the cane from the mother plant is severed just below ground level and the new vine may be permitted to carry a reasonable crop. Layering should be done while the vines are dormant.

IRRIGATION.

With irrigation, grapes can be grown in low rainfall areas, many of which are capable of producing good fruit. However, before purchasing the necessary equipment, the available water should be analysed to determine its suitability for irrigation.

Overhead irrigation is apt to encourage disease outbreaks in the vineyard and water is therefore best applied in furrows. Sufficient water should be used to wet the soil in the root zone, particularly after the harvest and in early spring if the soil is at all dry. However, the vineyard must not be irrigated while the vines are flowering or just prior to the commencement of harvesting unless the vines are obviously suffering from lack of sufficient moisture.

CULTIVATION.

The standard method of maintaining vigour and fruitfulness in the vineyard still consists of clean cultivation during the spring and early summer. However, cultivation methods should not accelerate erosion or destroy the structure of the soil. Only when it is necessary to kill deep-rooted weeds or to prepare the land for a cover crop is deep cultivation more effective than shallow cultivation. Otherwise nothing is gained by cultivating more frequently than is required to destroy weeds and keep the surface soil porous enough to retain and absorb rain.

Cultivation should be avoided while vines are in bloom, when they are setting their fruit and at times when late frosts are likely to occur.

FERTILIZING AND COVER CROPPING.

The fertilizing and manuring of the vineyard involves the addition of nutrients and organic matter to the soil. The amount of mineral plant foods annually removed from an acre of soil in an established vineyard is approximately 64 lb. of nitrogen, 40 lb. of phosphoric acid, and 90 lb. of potash. Such losses cannot go on indefinitely. The amounts of readily available plant foods in different soil types vary, but most vineyards respond to a complete fertilizer containing nitrogen, phosphoric acid and potash.

A yearly application in late winter or spring of a 4:12·5:6 or similar mixture at the rate of 4 cwt. per acre has given good results in the Stanthorpe area. The fertilizer may be spread on both sides of the row in a foot-wide band about two feet from the vine and turned in either with the cover crop or at the next cultivation. Alternatively, it can be broadcast over the land and ploughed or cultivated into the soil.

Nitrogen must be used with discretion. The vigorous soft vegetative growth produced by an excessively heavy application of nitrogen is undesirable; only a good average growth of canes is needed. A straight nitrogenous fertilizer is applied only when lack of vigour is due to an obvious nitrogen deficiency and not to bad drainage, overcropping or disease.

Cover Cropping.

In the Stanthorpe district, the soils are low in organic matter even in the virgin state and continuous cultivation leads to the rapid depletion of the humus content. It is therefore necessary to grow cover crops each year. Both legumes and cereals are used. Of the legumes, New Zealand blue lupin is the most important, and wheat and rye corn are the most popular cereals. These are grown as winter crops and fertilized before planting, the legume with 3 cwt. per acre of a 5:14:2 or similar mixture and the cereals with 1½-2 cwt. per acre of sulphate of ammonia.

The time of sowing is governed largely by the rainfall in late summer and autumn but the land is usually prepared for a March planting so

that the maximum benefit will be got from any autumn rains. Early sowing is always preferable to late sowing, as the crop should be well established before winter.

The cover crop is turned under before it reaches the flowering stage so that the residues are completely broken down by early spring. Young plants decompose more rapidly than those which are mature, and legumes more rapidly than cereals. As a general rule, non-leguminous crops should be incorporated into the soil six to seven weeks and legumes three to four weeks before budburst occurs in the vineyard.

PRUNING AND TRAINING.

The vine is a natural creeper which grows on fertile soil to a considerable size and produces long canes with very little fruit. Pruning, however, produces a plant with the shape more of a bush or shrub. It may be less vigorous than the wild parent but it has a greatly increased capacity to bear fruit and pruning is therefore a means of controlling the crop to ensure maximum yields of commercial quality fruit without impairing the health and vigour of the vine.

A few of the principles which influence pruning are:—(*a*) if a vigorous vine is checked, the production of fruit is increased in the following season; (*b*) the more a cane departs from a vertical position, the greater its production of fruit; (*c*) the canes furthest from the root are usually the most vigorous; (*d*) the greater the number of canes, the weaker they are, and conversely, the fewer the canes the greater is the vigour of each; (*e*) in vines of equal age and vigour, the more abundant the fruit, the lower is its sugar content.

Vines must be pruned during the winter (Plate 149) when they are completely dormant and the canes have matured. Early pruning should be avoided, except in coastal districts where late frosts are exceptional. By pruning in late August at Stanthorpe, budburst can be delayed for a fortnight or even longer, and this delay frequently reduces the risk of frost injury. Late pruned vines bleed profusely from the cut surfaces but the loss of even large quantities of sap has apparently no ill effects on either fruit production or growth of the canes.

Plate 149.

Collecting Prunings With a Horse Rake.

In wet climates it is customary to cut through the node, exposing a hard surface which, to some extent, prevents the entry of water and subsequent decay. However, in Queensland, conditions during the dormant period are relatively dry and the cut is usually made above the bud.

The dormant base buds in many varieties of grapes do not produce fruit-bearing canes and they are, therefore, not taken into consideration when pruning. Should the first or second true buds on the cane be damaged or fail to develop, the base buds are forced into growth and provide pruning wood for the following winter.

There are two methods of pruning grape vines—short pruning and long pruning. Varieties of grapes which bear their fruit on the canes arising from the first and second buds are "short pruned" to the first two buds. The small length of cane thus left for fruit-bearing purposes is referred to as a "spur." Such varieties as Gros Colman, Royal Ascot, Black Hamburg, Servant and Muscat Hamburg crop quite satisfactorily when short pruned, especially in the Stanthorpe district.

In other varieties, the best fruiting canes develop from the fourth and fifth buds and even further along the cane. Varieties of this type are long pruned to a length of cane called a "rod" with six to eight or even more buds. Vines with exceptional vigour may be long pruned to a rod of four or five buds and allowed to bear heavier crops than less robust varieties. For every rod left for fruit-bearing purposes a spur pruned to two buds must also be left at its base. The spur is not required for fruit but provides renewal wood for the following year. When pruning, the rod is completely removed, the uppermost cane of the spur is shortened to a rod, and the lower cane is pruned to a spur of two buds. The same procedure is repeated each year. In the Stanthorpe district, Waltham Cross, Purple Cornichon and White Syrian varieties crop best when long pruned, especially under the Casanave Cordon system.

Unilateral Cordon System of Short Pruning.

In a year-old vine, the most upright growing cane is selected and shortened back to three buds. This main cane will form the trunk of the future vine. In the second winter, the leading cane is given a graceful curve on to the first wire and shortened back to a bud on the under surface (Plate 150). The new growth from this end bud will then lie almost flat along the wire and lengthen the main arm in the next year. All other canes are cut out.

In the third pruning, fruit-bearing spurs are formed on the top surface of the main arm by pruning selected canes back to two buds. The spurs should be spaced about six inches apart and the first spur must be beyond the curved neck of the vine. A section of the cane at the end of the main arm is laid down along the wire with the last bud of the new section on the under surface, as in the previous year. Two canes should be produced in the following summer from each spur—that is, one from each of the two buds.

In the following winter, the cane growing from the bottom bud of each spur is pruned to two buds. All other growth appearing above it, including the cane which has carried a crop, is cut away. Pruning from now on consists of treating the existing spurs in this way, forming new spurs and laying down a section of the end cane until the main arm attains the required length. When this stage is reached, the last spur on the vine needs different treatment. From the two canes that appear at this point, the uppermost one is pruned to several buds and

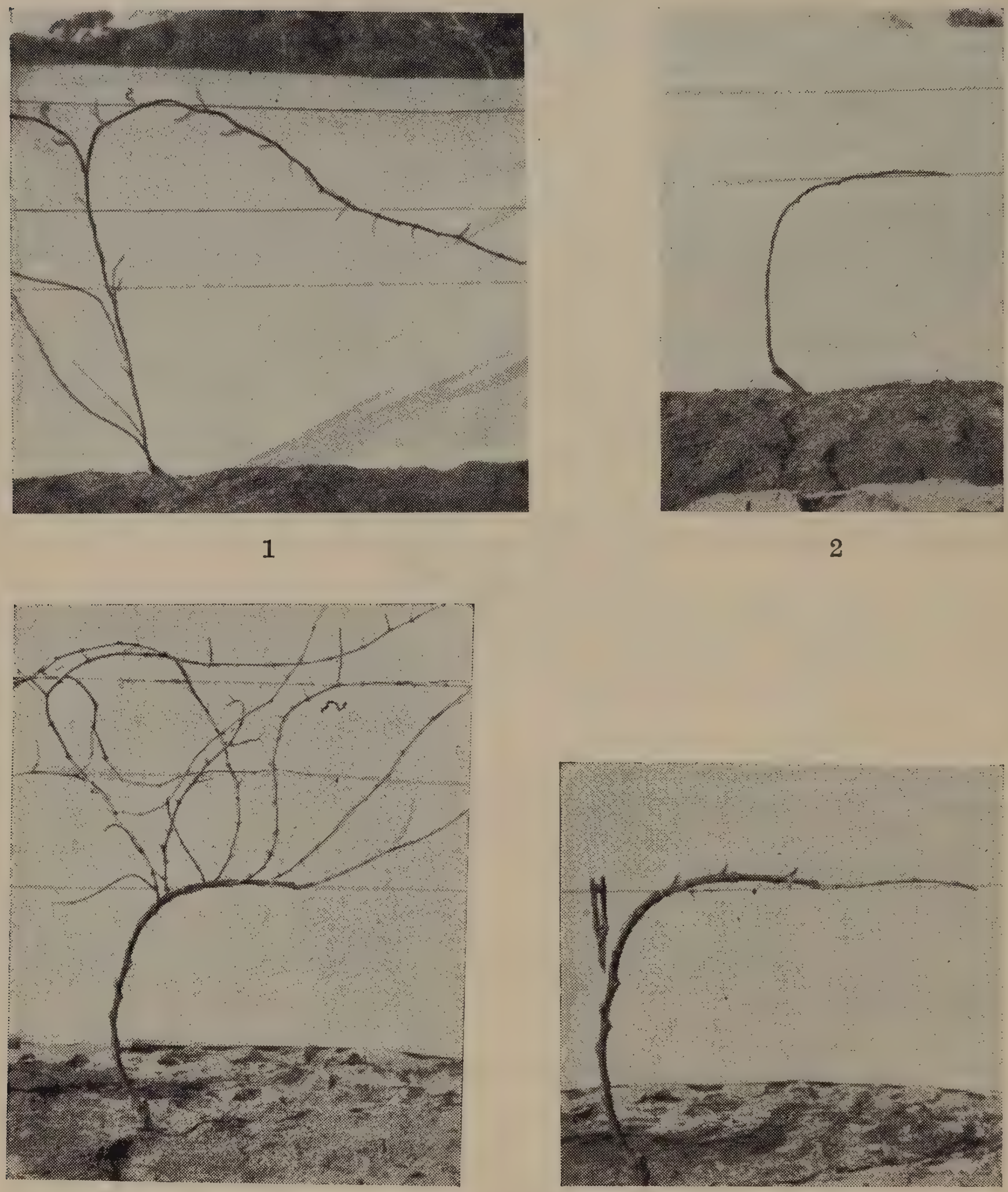


Plate 150.

Unilateral Cordon System of Pruning. 1, a two-year-old vine before pruning; 2, the same vine after pruning; 3, a three-year-old vine before pruning; 4, the same vine after pruning.

tied down to meet the first spur of the adjoining vine. The lower cane is then shortened back to a spur of two buds, which should produce canes in the following summer. In winter, these two canes will be treated in the same manner.

After a few years, the spurs on short-pruned vines tend to become twisted, knotty and much longer than is desirable (Plate 151). To avoid this, any water shoots appearing about the base of the spurs should be preserved; they can be used in the following year to form fresh spurs which replace the old ones. Old spurs should be removed while they are comparatively small.

Plate 151.

A Vine With Bad Spur Growth. New spurs should have been established earlier from water shoots at the dormant base buds and the old spurs removed.

Bilateral Cordon System of Short Pruning.

The Bilateral Cordon (Plate 152) is a two-armed vine trained to resemble as closely as possible the letter T.

In the spring of the first year a strong, upright shoot from the young plant is selected and the growing point is pinched off about four inches below the first trellis wire; the top bud will later send out another shoot and this shoot is also pinched back when it is a few inches long. Several shoots will then appear, but only the top one should be allowed to grow, the others being suppressed in order to encourage the growth of the top cane.

Plate 152.

Bilateral Cordon System of Pruning. The vine is trained to two arms, each of which is pruned in the same way as a unilateral cordon.

By the following winter, the cane will have produced several buds just below the wire. The vine should be pruned at this point and the stem tied to the wire. Next spring, two shoots at about the same level are selected and trained in opposite directions along the wire to form the main arms. All other growth should be kept suppressed.

The canes arising from the two main arms are pruned to spurs with two buds as in the Unilateral Cordon method.

Bordelaise Espalier System of Long Pruning.

The Bordelaise Espalier method of long pruning (Plate 153) is suitable for strong growing and shy bearing vines. A strong, upright growing cane from a young vine is pruned through the node at the height of the first wire and securely tied to it. Several canes will appear in the next growing season. In the following winter the two uppermost of these canes are both shortened back to spurs with two buds and all other growth on the main stem is cut away. These spurs will then produce two canes. At the next pruning period, the top cane on each spur is cut back to a short rod of four or five buds and the two rods are tied down as bows facing in opposite directions on the bottom wire. The lower cane on each spur is pruned to two buds.

Plate 153.

Borderlaise Espalier System of Pruning. The basal cane is pruned to a spur of two buds and the upper cane to a rod of four or five buds.

At subsequent prunings, the rod that has borne the fruit during the previous summer is completely removed, and the two canes issuing from each of the spurs are treated as in the previous winter, that is, the upper one forming the rod and the lower one the spur. The rods are required purely for fruit-bearing purposes. The spurs may produce fruit but their chief function is to supply canes from which new rods and spurs can be made at the following pruning.

Casanave Cordon System of Long Pruning.

The Casanave Cordon method of long pruning (Plate 154), like the Bordelaise Espalier, is suitable for strong growing vines.

The young vine is trained as a Unilateral Cordon until spurs are established on the main arm. The uppermost cane from each spur is then pruned to a rod of five or six buds and tied down to the main arm, the bottom cane being pruned to a spur of two buds. If only one cane has developed at a spur, it should be pruned to two buds.

As in the Bordelaise Espalier method, the rod is retained for fruit-bearing purposes, and is completely removed at the following pruning. The spurs provide renewal wood in the following summer.

Plate 154.

Casanave Cordon System of Pruning. The vine is trained as a unilateral cordon, but the two canes at each spur are pruned to the Bordelaise Espalier rod and spur systems.

Bush or Goblet System of Pruning.

No wire support is provided for vines pruned to the bush system (Plate 155) and it is essential that a single stout stem or trunk be established in the first two years. The most upright growing cane of the two-year-old vine is shortened back to a height at which the head of the vine is to be formed and tied securely to the stake by the internode above the top bud. In wine varieties and raisin grapes grown in a hot dry climate, the head should be eight to 10 inches from the ground; in table varieties a stem of from 12 to 16 inches is preferred.

At the third pruning the previous season's growth is trimmed to two spurs which will develop into main arms. In the following year, the eight canes available can each be pruned to two bud spurs. The number of spurs the vine is capable of carrying will depend entirely upon its vigour and its habit of bearing fruit. It is usual to reduce the number of spurs if the vine is making poor growth, and conversely, where the growth is good, more spurs may be allowed to remain. Once the frame of the vine has been formed, pruning consists in providing

sufficient spurs for the annual fruiting wood and spacing the spurs so that they will not overcrowd each other. Any old spurs that are knotty and elongated should be replaced by new and more vigorous growth.

In vines which do not fruit well when short pruned to spurs of two buds, two or more canes of the previous year's growth from two to three feet long may be left to bear fruit in the following season.

The Bordelaise Espalier method of pruning can be practised on vines trained to the bush or goblet method. In this case, the fruit-bearing rods are either twisted together in the form of a bow or bent down and tied to the base of the opposite spur.

Plate 155.

Harvesting From Vines Trained to the Bush or Goblet System.

Summer Pruning.

Summer pruning may be divided into two distinct operations—the removal of young shoots and pinching.

Unwanted shoots are removed when they are about 10 to 12 inches long and can be easily broken under pressure of the thumb and index finger; at this stage they should be sufficiently developed to show which of them will carry fruit. All water shoots issuing from the old wood should be removed unless they are needed to reform vines to replace spurs that have become elongated and knotty or to fill up a gap in the spurs.

In spur pruned vines, two or even three shoots may arise from each bud. Only the strongest should be left at each node. One shoot to each spur would probably be sufficient for the less vigorous vines; stronger growing kinds may support two or more shoots on each spur. On long pruned vines, the surplus shoots on the rods are removed and the strongest shoots on the spurs retained in order that good renewal wood will be available for the following pruning. Where necessary, water shoots should be retained to replace spurs.

Pinching assists the setting of the fruit. Some vines persist in setting their fruit badly, and nipping off the tips of the canes when the blossoms begin to open often has a beneficial effect upon the crop. Pinching also balances the growth from spurs. The end buds of the spurs on fruit-bearing rods are usually the first to commence growth. By pinching these shoots when they are a few inches long the other buds burst and make normal growth. Only vigorous vines should be pinched.

Repruning After Frost.

Spring frosts occasionally cause considerable damage to grape vines in the inland and tableland districts. Early sprouting varieties and vines which are forced into leaf prematurely by early pruning are naturally more susceptible to injury. Provided the damage occurs before the vines have made too much headway, it is possible to reprune and produce a light crop that will ripen satisfactorily under normal conditions.

Two, three or even four dormant buds are actually situated about the base of each obvious bud. They normally remain dormant, but in the event of injury to the young cane, the most forward of them is forced into growth. This dormant bud is capable of producing sound wood and in some varieties it is fruitful. A few days after frost, the damage is clearly defined and the injured shoots should then be removed at a point just below the first buds but not too close to the spur.

The method of repruning depends on the extent of the damage and the stage of growth of the young shoots. In the event of the shoots being frosted when they are but a few inches in length or less, they may be killed outright and there will be no need to touch the vines, as the dormant bud will automatically develop; if the young canes are only partly damaged by frost and sufficiently soft to snap off under pressure of the thumb, the work can be done by hand. Should the damage occur when the canes have become pithy, the secateurs or a sharp knife should be used; otherwise the basal buds may be destroyed. Occasionally some shoots showing fruit escape injury while the rest of the vine is badly damaged. These shoots must be pinched back so that the dormant eyes on the frosted spurs can develop. In repruned vines, water shoots appearing along the main arms and from the base of spurs must be rigorously suppressed.

Some varieties crop more freely when repruned than others. However, repruning aims not only at producing a crop of fruit but also at stimulating the development of suitable canes capable of producing a normal crop in the following year.

The Use of the Pruning Saw.

The pruning saw is not used a great deal in the vineyard, for the secateurs can deal with most of the pruning and the saw, if improperly used, can cause very serious damage to the vines (Plate 156).

When large saw-cuts are necessary, it is preferable to leave a projecting stub about two inches long. In the following winter, the dead portion of the stub can be removed and the wound protected from the weather by a good wax preparation or one of the bitumen products on the market.

Plate 156.

Open Wounds Made by Faulty Use of the Pruning Saw. The sawcuts are too close to the main arm.

Plate 157.

Picking Basket With Grapes. All the stalks are upward and the bunches can be handled without touching the fruit.

HARVESTING.

Fruit is picked during the cooler hours of the day and only when the bunches are dry. When cut, the bunches are trimmed of small or damaged berries and placed with the stalks upwards in baskets (Plate 157). The full baskets should be placed in a shady position pending transport to the packing shed. In the shed, a further check is made for faulty berries and the bunches are then spread out for ease of sorting and packing. Normally, the fruit is held on the bench for 24 to 48 hours and allowed to sweat before packing; the fruit is then less subject to injury when handled and loose packs are less common.

The fruit is packed in dump half-bushel, standard half-bushel or quarter-bushel cases, the last being very popular on some markets. The cases should be lined with paper and the bunches packed with the stalks to the centre. Tight packing is essential. For local markets, it is not necessary to incorporate a filler in the pack, but export or long distance shipments must be packed with granulated cork, sawdust or woodwool. The first of these is unquestionably the best.

Citrus Improvement.

In a report on the operations of the Horticulture Branch during 1950-51, the Director of Horticulture (Dr. S. A. Trout) states that the Department supplied nurserymen's requirements of citrus seed and budwood as in previous years, but good budwood of the Emperor mandarin and Marsh grapefruit has been scarce because of the difficulty of obtaining trees free from brown spot and stem pitting, respectively.

A range of mandarin seedlings has been propagated at Redlands Experiment Station and some useful varieties are expected. An increase in the production of mandarins in Queensland is anticipated, because this fruit is well suited to Queensland conditions and markets are available in the Commonwealth and overseas.

Nursery inspections indicate that pests and diseases are reasonably well controlled and that tree quality is improving. For some important varieties, sweet orange stock is preferred. Though an excellent stock in inland districts, it may not be the solution to the problem in coastal districts where brown rot gummosis occurs. The resistance of trifoliata stock to the disease has been established in New South Wales and disease-free trees have been imported to Queensland for observation purposes.

Mould wastage is still prevalent in citrus fruits marketed locally and overseas. Some measure of control has been obtained with fungicidal dips, and pre-packing treatment may have to follow the procedure adopted in many southern packing houses. The future of the Australian citrus industry is dependent largely on overseas export, and research will have to be intensified if markets are to be retained and expanded.

Queensland Certified Seed.

F. B. COLEMAN, Registrar, Seed Certification.

QUEENSLAND certified seed is grown for sale by selected growers, under strict supervision by seed certification officers. The mother seed for use by certified seed growers is developed by plant breeders of the Department of Agriculture and Stock, or, in the case of hybrid maize, of the Queensland Agricultural High School and College.

Seed will not be certified by the Seed Certification Committee of the Department unless it is of a very high standard as to trueness to type and freedom from impurities and from specified diseases.

Queensland certified seed can be identified by the presence of seals and labels attached by or under the supervision of officers of the Department (see Plate 158). Queensland certified seed is NOT SOLD in unsealed, unlabelled or open bags.

Comments on the seeds grown for certification in Queensland and the growers who produced same during the 1950/51 season are given hereunder.

Queensland Certified Hybrid Maize.—Can be expected to yield 15 per cent. more grain than open pollinated crops.

Hybrid.	District Recommended and Grower.
Q462 ..	*South Coast, Brisbane and Lockyer Valleys*— E. M. Shaw, Innisplain, *via* Beaudesert
Q793 ..	*Brisbane, Lockyer and Fassifern Valleys*— E. M. Shaw, Innisplain, *via* Beaudesert
Q629 ..	*South Coast, South Burnett, Brisbane and Lockyer Valleys*— L. W. J. Markwell, Kingaroy E. R. Schwarz, Lamington, *via* Beaudesert H. T. Tommerup, Central Kerry, *via* Beaudesert
Q658 ..	*South Coast*— H. T. Tommerup, Central Kerry, *via* Beaudesert L. W. J. Markwell, Kingaroy
Q739 ..	*North portion of South Burnett, Brisbane and Lockyer Valleys, Darling Downs*— E. R. Schwarz, Lamington, *via* Beaudesert L. W. J. Markwell, Kingaroy
Q717 ..	*Brisbane, Lockyer and Fassifern Valleys*— W. A. Bateman, Flagstone Creek, *via* Helidon
Q716 ..	*North portion of South Burnett, Brisbane, Lockyer and Fassifern Valleys, South Darling Downs*— J. A. Moore, West Wooroolin A. W. Bachmann, M.S. 182, Laidley D. E. Poulsen, "Beechwood," Box 460, Cooroy S. L. Marshall, Wooroolin
Q23 ..	*South Coast, South Burnett, Brisbane and Lockyer Valleys*— G. J. A. Haack, Block 8, Mundubbera L. W. J. Markwell, Kingaroy
Q431 ..	*North portion of South Burnett, Brisbane and Lockyer Valleys*— D. E. Poulsen, "Beechwood," Box 460, Cooroy L. W. J. Markwell, Kingaroy
Q499 ..	*Brisbane and Lockyer Valleys*— D. E Poulsen, "Beechwood," Box 460, Cooroy
Q440 ..	*North portion of South Burnett, Lockyer and Fassifern Valleys, South Darling Downs*— E. U. McCarthy, Allan street, Gatton
Q719 ..	*North portion of South Burnett, North and South Darling Downs*— L. W. J. Markwell, Kingaroy
Q692 ..	*South Burnett*— R. C. Andrews, Booie road, Nanango

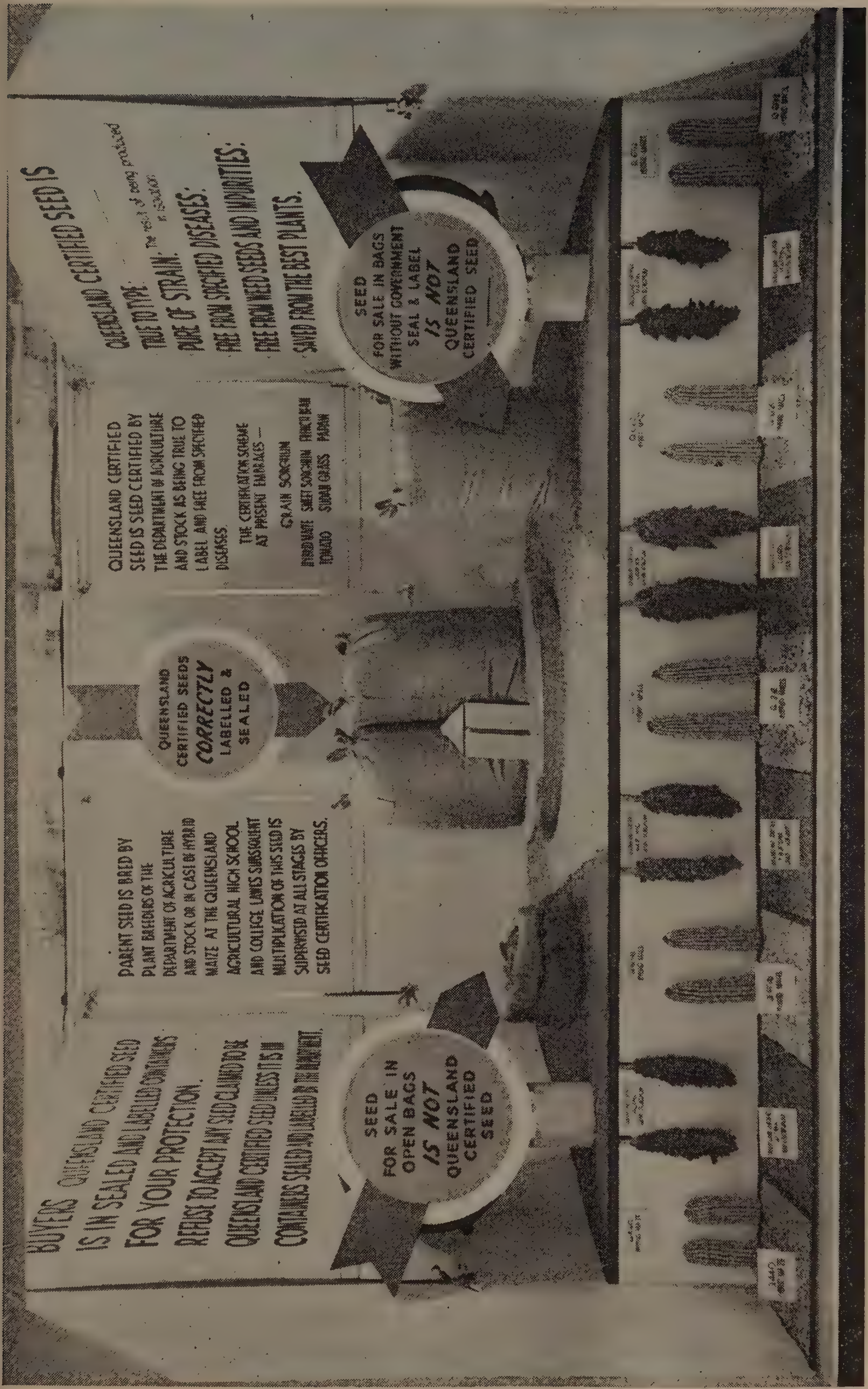


Plate 158.

A Display Explaining the Merits and Means of Identifying Queensland Certified Seeds.

Queensland Certified Sorghums—are noted for their uniformity in the field, permitting easier harvesting and reducing wastage.

Variety.	Grower.
Grain—	
Wheatland	C. J. Turner, Wooroolin
	N. E. Heitmann, Gayndah
	S. L. Marshall, Wooroolin
	L. V. Young, Wooroolin
Kalo	M. Stower and Son, M.S. 35, Dalby
Early Kalo	L. W. J. Markwell, Kingaroy
Alpha	S. Johns, Jondaryan
	L. W. J. Markwell, Kingaroy
Martin	L. W. J. Markwell, Kingaroy
Caprock	L. W. J. Markwell, Kingaroy
Sweet—	
Sugardrip	L. W. J. Markwell, Kingaroy
Honey	S. J. Neylon, Monto
Italian	L. W. J. Markwell, Kingaroy

Queensland Certified Sudan Grass—is free from Johnson Grass.

Roma	T. E. Bassett, Branch Creek, Gayndah
	L. E. Savage, Ideraway
	N. L. Stiller, Guluguba, *via* Miles
	L. W. J. Markwell, Kingaroy

Queensland Certified Tomato Seed—specially selected for suitability for growing in the Stanthorpe area, high yield and general attractiveness of fruit for market.

Variety.	District Recommended and Grower.
Q1 (derived from Sioux)	*Stanthorpe*— E. F. Wain, Bapaume
Q2 (derived from Grosse Lisse)	*Stanthorpe, and should do well in other parts of Queensland* Harslett Bros., Amiens
Q3 (derived from Valiant)	*Stanthorpe*— C. Couchman, Glen Aplin
Q4 (derived from Rutgers)	*Stanthorpe, and should do well in other parts of Queensland*— R. W. Carnell, Severnlea

Queensland Certified Bean Seed—It is regretted that, owing to circumstances outside the growers' control, there will not be any Queensland Certified Brown Beauty French Bean seed this season.

Queensland Certified Papaw Seed will not be available until next year.

Copies of the rules governing the certification of seeds in Queensland may be obtained on application to the Standards Branch, Department of Agriculture and Stock, William Street, Brisbane.

RADIO TALKS TO FARMERS
(Australian Broadcasting Commission)
4QR AND REGIONAL STATIONS
THE COUNTRY HOUR—Daily from 12 noon to 1 p.m.
4QG AND REGIONAL STATIONS
COUNTRY NEWS MAGAZINE—Every Sunday at 9 a.m.

PLANT PROTECTION

Control of Red Scale on Figs.

A. R. BRIMBLECOMBE, Entomologist, Science Branch.

RED scale (*Aonidiella aurantii* (Mask.)) derives its common name from the reddish parchment-like scale covering the insect. It occurs on a variety of plants in most countries of the world and is a persistent pest of citrus wherever grown. This insect thrives in a hot, dry climate and in Queensland is more troublesome inland than near the coast. In recent years, however, fig trees in the Sunnybank district have been infested, with serious effects on fruit quality and yield.

Nature of Damage.

Heaviest infestations occur on the branches, mainly because the trees are deciduous. These have a direct influence on tree vigour though it may not be apparent in the production of foliage. The most striking feature is the large proportion of undersized and leathery-textured fruit, more particularly towards the end of the season. When the insects spread to the fruit and foliage, fruit quality is further reduced while the leaves develop a leathery texture and harsh appearance and tend to fall early. The picking period may therefore be considerably shortened, with consequent reduction in yields.

Life History.

Red scale does not lay eggs but gives rise to living young or "crawlers." These are minute, oval and pale yellow and are barely perceptible to the naked eye. They crawl from beneath the parent and move to a new place to settle down, which normally occurs within a few hours. Soon after commencing to feed they secrete a whitish circular covering, which changes to yellowish red as the insects grow and in the females enlarges to about a tenth of an inch in diameter. The mature male scales are oval in shape and smaller in size.

There may be four or five generations of red scale in a year. With considerable overlapping of these generations, a certain amount of breeding is taking place continuously and individuals of all ages may be present at any one time. However, greatest breeding occurs during the summer months, and it is in this period that the insects spread to the new twigs, leaves and fruit. High temperatures favour insect activity and infestations may become intense, especially if the weather is dry.

Populations are later reduced by leaf fall and pruning but infestations remain on the branches, where the pest carries through the winter.

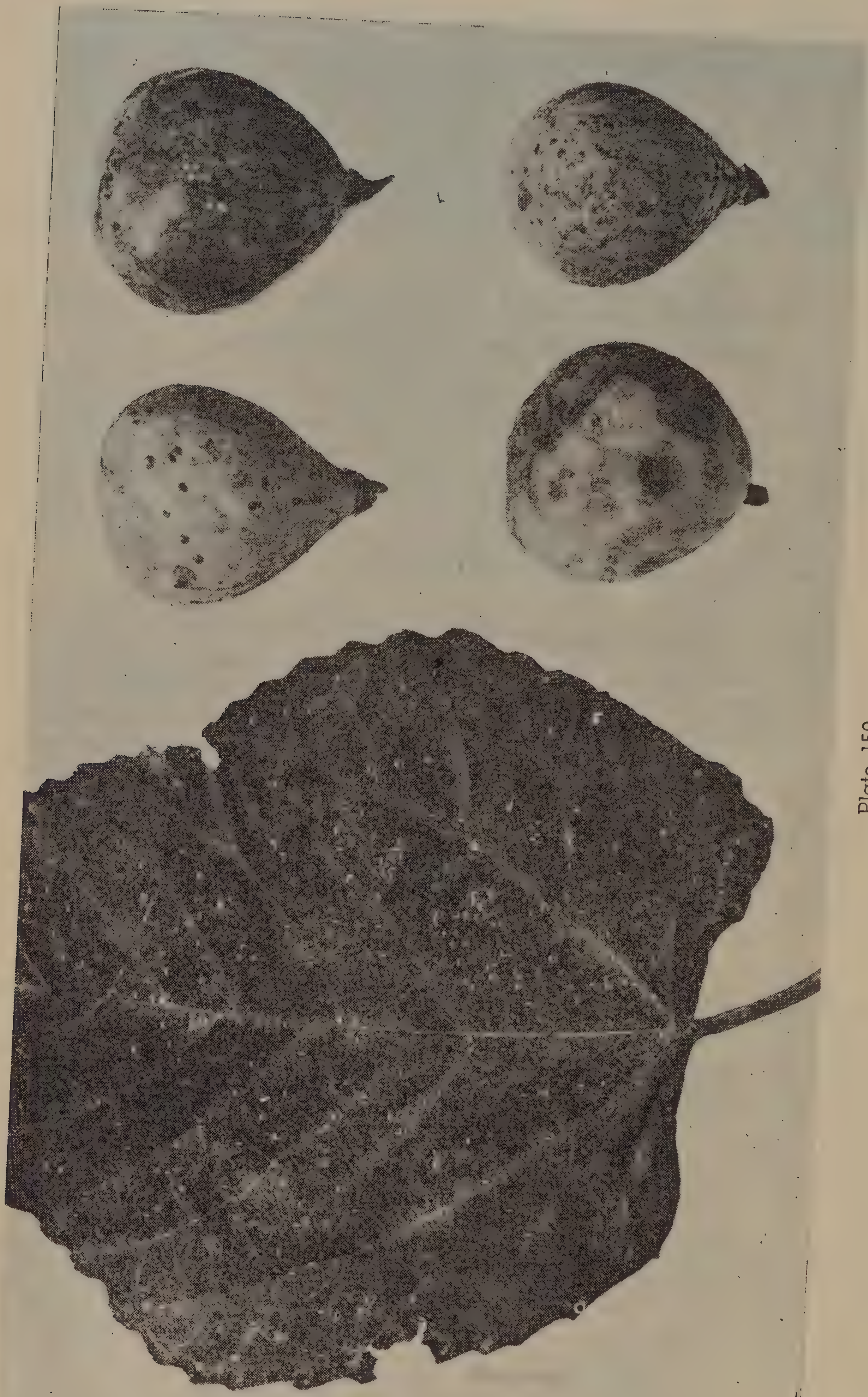


Plate 159.

Red Scale Infestation on Fig Leaf and Fruit.

Control.

Mature insects of red scale, due to their protective covering, are not readily killed by insecticides, but the unprotected crawlers and newly settled young are vulnerable to efficient spraying. Investigations have shown that several sprays will kill these young stages, but best results are obtained with white oil at a strength of one gallon to 40 gallons of water.

A lime sulphur spray, one gallon to 15 gallons of water, as normally applied in late winter for checking brown leaf spot disease, has some value against red scale. However, more direct action against the pest is best during the summer months. This checks the emerging young on the branches before many have moved to the new twigs, leaves and fruit and also kills most of those that have moved. Two applications, spaced at an interval of two or three weeks, are necessary. If the infestation is heavy in winter two applications of the lime sulphur could be made, and if the two summer applications of white oil have not been sufficient two more could be made after fruit picking has been completed.

Since infestations of red scale cannot be entirely eliminated, breeding can continue and therefore control should be regarded as a routine each year. For this purpose the minimum is **one application of lime sulphur (1 in 15) in late winter and two applications of white oil (1 in 40) in summer.** The insect should then remain in such low numbers that its effect on the trees is negligible.

Lichens On Citrus Trees.

Lichens, which are a very lowly form of plant life, are common in the wet coastal districts of Queensland, and in a citrus orchard are usually found on the trunks and larger branches of old or neglected trees as grey, paper-thin growths pressed close to the bark or as greyish-green, branched, thread-like tufts standing out from the bark.

Though many orchardists believe that lichens are harmful to the tree, this is not the case. Their presence indicates that the infested trees are in an unhealthy or neglected condition. The lichens actually obtain their food from the air and from decaying matter in crevices in the bark.

Usually no special measures need be applied to control the growth of lichens. The lime-sulphur spray applied in late winter for the control of white louse, Maori mite and bud mite, and the cuprous oxide mixture applied at other times for disease control, both check the development of lichens. Appropriate measures for the improvement of the health of the trees should also be undertaken to hasten the disappearance of the lichens.

Dairy Sire Surveys.

C. H. CLARK, Division of Dairying.

REALISATION of the inadequacy of type and pedigree as guides to selection of dairy cattle has recently focussed attention on the value of proven sires for improving milk and butterfat production.

The sire can be assessed by the producing qualities he is actually transmitting to his progeny—that is, by means of the progeny test—whereas the cow very rarely has sufficient progeny to enable a similar test to be carried out. Approximately 12 to 15 heifer calves would be sired by the average bull annually (from an average of about 30 calves), and as he usually has a working lifetime of at least three years, it follows that from 40 to 50 heifer calves would be available in his lifetime, as compared with two or three heifer calves from the average cow. Therefore, on the average the bull is about 20 times more important than the cow in determining the quality of future generations of dairy stock and he will have a very great bearing on the future producing qualities of any particular herd or group of herds.

The emphasis in herd recording work, so far as breeding is concerned, is therefore placed on progeny testing in the case of the bull; and the use of lifetime records in the case of the cow. In the first case, information is made available on the actual milk and butterfat producing qualities being transmitted to the progeny of the bull; and in the second, the lifetime record of the dam indicates the degree to which she has combined the five qualities necessary for a sound dairy cow—namely, sound milk and butterfat production qualities; fertility (ability to calve regularly); resistance to disease (sound constitution); length of working life; and good milking temperament. The principle of a series of records for the dam of the bull and the use of a sire survey (as the progeny test of the bull is now known) will replace the emphasis on selection and use of a bull on the basis of a single record of production by his dam.

The simplest type of sire surveying consists of the average record of a sire's offspring. If the dams to which sires are bred are an average of the breed as a whole, then such progeny records can be used to measure the breeding value of any two sires concerned. If, however, the mates of one sire were considerably above breed average, and those of the other sire considerably below it, then such comparisons would not be justified.

Another type of survey is the comparison of the average production (maturity equivalent) of all daughters of the sire with the average production of their respective dams. A survey of this nature is made difficult by the fact that only a small proportion of dams remain in the herd until their daughters come into milk. This means that for a number of surveys, the comparison would be based on few daughter-dam pairs, and in some cases no comparison would be available. Even where daughter-dam comparisons are available the dam's average may be misleading as an indication of environmental conditions, especially where the dams are highly selected.

A further method of compiling a survey is in the form of a comparison of the average production (maturity equivalent) of all the daughters of a particular bull with the average production of the other mature cows in the herd under the same conditions. The average of all mature cows in the herd should give a more reliable indication of environmental conditions, and a comparison of this average with the daughter average should indicate more clearly than a daughter-dam comparison the likely effect which the bull under survey will have on the future production of the herd.

It is obvious that before any survey can be compiled the production records of both dams and daughters must be corrected to some standard basis. Correction factors for age have been calculated, and corrections will be made for 2-year-old, 3-year-old and 4-year-old production records, the maturity basis being the average production of cows 5-10 years of age. These correction factors have been calculated from all available Pure Bred Herd Recording data during the period 1930-50.

In one part of the analysis a straight tabulation of single 273 days lactation records of cows of each breed for different ages was compiled—that is, the records of all cows two years of age were added and averaged, and the same procedure was followed for the various ages. In another part of the analysis, cows which had a mature production record and also had been tested at least once before reaching maturity were listed and the average 2-year-old, 3-year-old or 4-year-old production was compared with the average mature production. In another part of the study, cows with two consecutive lactation records (for example, records as 2-year-olds and as 3-year-olds) were examined in an effort to determine the degree of slope of production.

It was found that correction factors derived from a straight tabulation of single lactation records were slightly higher than those derived by other methods. In the other analyses the number of cows with two lactation records, or with consecutive lactation records, was small and it was found that a great deal of variation existed between individuals. It was therefore considered that factors calculated from these analyses were less accurate than those calculated from a straight tabulation.

The actual correction factors calculated are as follows:—

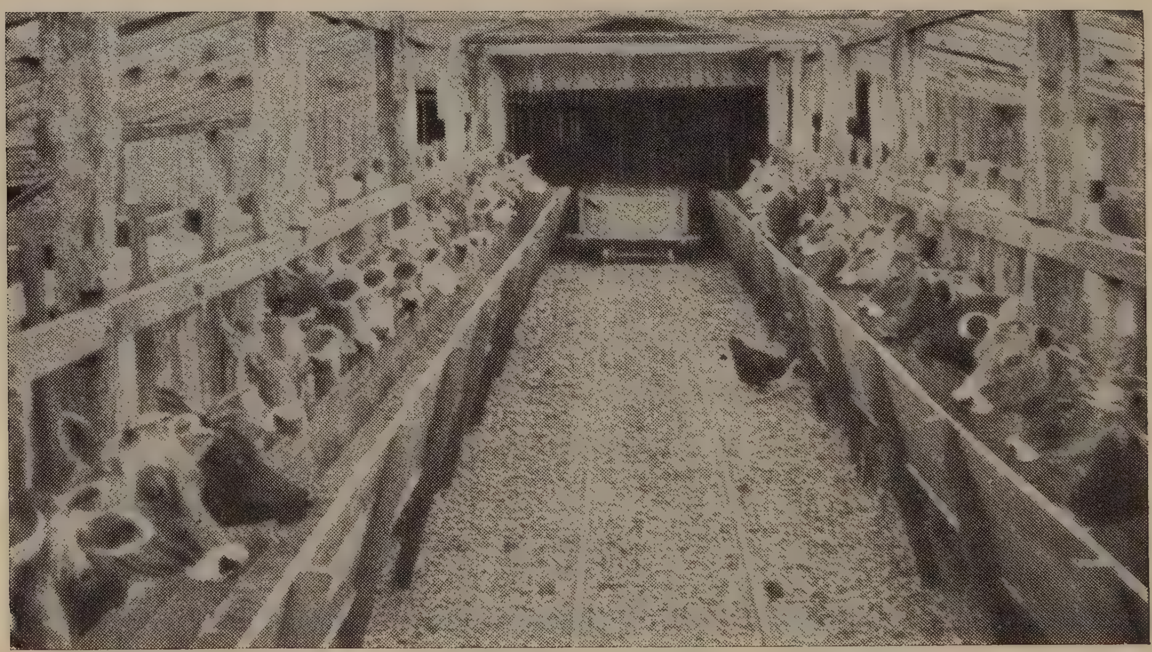
Breed.	Correction Applied to 2-year-old Record.	Correction Applied to 3-year-old Record.	Correction Applied to 4-year-old Record.
A.I.S. ..	40% (1·40)	20% (1·20)	10% (1·10)
Jersey ..	35% (1·35)	15% (1·15)	5% (1·05)

The data available were insufficient to calculate "age correction factors" for other breeds. As more cows are recorded in ensuing years and for the whole of their lifetimes, and as further survey work is carried out, more data will become available for a further examination of "age correction factors." It is probable that the above factors will not be as accurate as desired; so a constant check will be kept on these figures and if necessary as additional data become available adjustments made.

It is realised that these factors are not likely to do justice to every sire under survey. In the case of a sire that leaves slow-maturing stock, the records of his two-, three- and four-year-old daughters will be under-corrected; while the daughters of other sires may fail to reach, at maturity, the level of production calculated from immature records. However, for the majority of bulls these factors give a reasonably reliable estimate of what an unselected sample of daughters should average as mature cows.

It is appreciated that an average purebred bull will effect an improvement in the production of poor producing herds, whereas in high producing herds the average bull will be unable to maintain production. A practical method of showing survey results would be by indicating how much better or how much worse are the results of any particular survey when studied in comparison with the results of all bulls used in herds of the same production standard. An attempt was made to compile a table showing the expected daughters' production of bulls used in herds of various production levels, but owing to lack of sufficient data it was impossible to prepare an accurate table.

Until more data become available from the continuous recording of more cows by breeders of purebred cattle, sires in this State will be surveyed on the average production of all recorded daughters provided at least 10 daughters have been recorded. Also the daughters' records will be computed according to age and will be corrected to maturity equivalent production. When more data become available, an expectancy table will be compiled and the issue of more comprehensive surveys will be possible.



The Feeding Stalls on a South Burnett Dairy Farm.

Report on Group Herd Recording for the Year Ended September 30, 1950.

S. E. PEGG, Senior Adviser (Herd Recording).

THE herd recording year which ended on 30th September, 1950, was fairly satisfactory for dairying. Some districts were adversely affected by the heavy rainfall in the early portion of 1950, and the production figures would suggest that the Eastern Downs was affected more than other districts.

During the year, 37 groups were in operation. The formation of new groups was hindered by lack of equipment, mainly milk test flasks and testing machines.

Results of completed lactations were obtained from 34 groups, and in the compilation of the production averages given only the first 270 days of any lactation were included. Again this year, there were a number of cows with very short lactation periods. No attempt has been made to "boost" the average production of the State by excluding these animals; it is considered that as members of our cow population they should be included.

In some groups it appears to be the policy of some farmers to cease recording after 12 months and then record again after a lapse of a year or two, but it is pleasing to note that a number of farmers who continue recording from year to year are showing an increased production per cow due to a policy of culling, together with an improved standard of husbandry. It is hoped that within a few years a greater increase will be obtained from improved breeding methods.

Table 1 gives according to age groups the number of cows, their average production of milk and butterfat, and for comparison the average yield of butterfat for each age group in 1948-49.

It will be noted that the large number of cows of unknown ages still continues, but as herd recording increases it is expected that farmers will keep better herd records.

TABLE 1.

NUMBER OF COWS AND THEIR AVERAGE PRODUCTION ACCORDING TO AGE GROUPS.

Age Group.	Number of Cows.	Milk.	Average Butterfat Test.	Butterfat.	Butterfat. 1948–49.
		Lb.	%	Lb.	Lb.
2 years ..	1,197	2,929	4·5	131	136
3 years ..	1,364	3,403	4·4	151	140
4 years ..	1,503	3,696	4·4	162	148
Mature ..	4,947	3,959	4·3	169	160
Unknown ..	13,381	3,408	4·3	146	139
Total ..	22,392	3,523	4·3	152	144

Figures issued by the Government Statistician give the average production of milk per cow for 1949/50 as 270 gallons. At an average butterfat content of 4·3 per cent., this would be equal to 116 lb. butterfat. The average production of the recorded cows—152 lb. butterfat—is much higher than the estimated average, but it is considered that a State average of at least 200 lb. butterfat should be the aim of the dairying industry.

TABLE 2.

Average Production per Cow, Number of Herds and Number of Cows Completing Lactations for the Various Groups in 1949–50.

Unit.	Herds.	Cows.	Milk.	Test.	Fat.	Fat, 1948–49.
			Lb.	%	Lb.	Lb.
Allora	18	457	4,449	4·0	177	185
Beaudesert	20	1,081	3,757	4·3	160	129
Brigalow	19	591	3,907	4·0	157	..
Cedar Pocket ..	19	760	3,207	4·7	151	132
Cooroy No. 1 ..	25	848	3,266	4·7	153	121
Cooroy No. 2 ..	32	607	2,849	4·6	130	102
Eungella	10	82	2,881	4·5	131	..
Goomeri	22	935	3,122	4·1	129	121
Gympie	17	500	2,716	4·6	125	..
Kenilworth	20	892	3,559	4·6	164	131
Kilcoy	19	850	2,718	4·4	120	113
Killarney	19	711	3,511	4·4	154	161
Kingaroy No. 1 ..	23	788	3,724	4·0	150	150
Kingaroy No. 2 ..	30	765	3,657	4·0	147	120
Kingaroy No. 3 ..	12	137	3,147	3·8	120	..
Kooralgin	17	211	3,715	4·2	157	..
Malanda No. 1 ..	26	815	4,116	4·4	180	163
Malanda No. 2 ..	20	546	3,840	4·3	166	..
Maleny No. 1 ..	19	682	3,551	4·9	176	155
Maleny No. 2 ..	15	451	3,870	5·1	197	145
Miles	21	913	3,012	4·0	121	..
Millaa Millaa ..	30	563	4,027	4·4	178	153
Miva-Theebine ..	15	699	2,726	4·6	126	102
Monto	20	956	3,832	4·1	156	160
Oakey No. 1 ..	21	655	3,473	4·3	149	184
Oakey No. 2 ..	22	807	4,274	4·2	179	186
Oakey No. 3 ..	26	847	3,947	3·9	156	149
Pomona	15	408	3,260	4·7	153	118
Ravenshoe	21	270	3,046	4·7	144	..
Toogoolawah.. ..	22	548	3,133	4·1	128	119
Toowoomba No. 1 ..	29	606	3,463	4·5	156	154
Toowoomba No. 2 ..	30	841	3,680	4·2	154	148
Warra	20	1,004	3,325	4·0	133	..
Warwick	21	566	4,308	4·2	179	190

Table 2 shows the average production of cows in each herd recording group. Several of the groups, which have been in operation for some time and which still retain many of the original members, show a marked increase in the average production.

For example—

Beaudesert 129 to 160 lb. butterfat;

Cooroy No. 1 121 to 153 lb. butterfat;

Pomona 118 to 153 lb. butterfat.

Table 3 gives the average production according to main districts of the State. As mentioned previously, the wetness of the season affected production on the Downs and resulted in a lower average yield. The results for Mackay cannot be taken as a criterion of the district's capabilities, as only a few cows had completed lactations.

TABLE 3.

AVERAGE PRODUCTION PER COW ACCORDING TO DISTRICTS.

District.	Herds.	Cows.	Average Production.			1948–49 Butterfat.
			Milk.	Butterfat.	Butterfat.	
			Lb.	%	Lb.	Lb.
Eastern Downs . .	186	5,490	3,867	4·2	162	173
Western Downs . .	60	2,508	3,348	4·0	134	. .
South-eastern Queensland	255	8,537	3,250	4·6	149	128
Lower Burnett . .	87	2,625	3,460	4·0	140	131
Upper Burnett . .	20	956	3,832	4·1	156	160
Mackay	10	82	2,881	4·5	131	. .
Atherton Tableland	97	2,194	3,893	4·4	172	160

The average production of butterfat in the lowest and highest producing herds in each district, according to herd size ranges, is shown in Table 4.

TABLE 4.

AVERAGE PRODUCTION OF BUTTERFAT OF THE LOWEST AND HIGHEST HERDS IN EACH OF THE MAIN DISTRICTS ACCORDING TO SIZE OF HERD.

District.	Lowest Herd. Average Production of Butterfat.				
	1–10 Cows.	11–20 Cows.	21–50 Cows.	51–100 Cows.	Over 100 Cows.
	Lb.	Lb.	Lb.	Lb.	Lb.
Eastern Downs	55	84	61	107	121
Western Downs	31	69	83	57	138*
South-eastern Queensland	46	75	33	86	96*
Lower Burnett	61	74	72	89	. .
Upper Burnett	45	79*	130	91	157*
Mackay	104	94	. .	. .	. .
Atherton Tableland . .	66	82	111	161	133*

District.	Highest Herd. Average Production of Butterfat.				
	1–10 Cows.	11–20 Cows.	21–50 Cows.	51–100 Cows.	Over 100 Cows.
	Lb.	Lb.	Lb.	Lb.	Lb.
Eastern Downs	268	236	286	228	127
Western Downs	62	198	214	182	138*
South-eastern Queensland	221	264	285	256	96*
Lower Burnett	223	203	232	243	. .
Upper Burnett	109	79*	224	200	157*
Mackay	217	139	. .	. .	. .
Atherton Tableland . .	297	224	269	233	133*

* Indicates only herd in that herd size in district.

It will be noted that the lowest herd average was 31 lb. butterfat per cow and the highest 297 lb. butterfat—a difference of 266 lb. butterfat per cow.

TABLE 5.

NUMBER AND PERCENTAGE OF COWS GROUPED ACCORDING TO AGE AND BUTTERFAT RANGE.

Age Group.		Under 50 lb.	50–99 lb.	100–149 lb.	150–199 lb.	200–249 lb.	250–299 lb.	300–349 lb.	350–399 lb.	400–449 lb.	450–500 lb.	Over 500 lb.
2 years ..	Number ..	106	236	430	300	94	29	1	1	..	..	..
	Per cent. ..	8·86	19·72	35·92	25·06	7·85	2·42	·84	·84	..	..	..
3 years ..	Number ..	71	217	400	381	215	56	20	2	2	..	..
	Per cent. ..	5·21	15·91	29·33	27·93	15·76	4·11	1·47	·15	·15	..	..
4 years ..	Number ..	62	191	401	440	266	106	27	7	3	..	..
	Per cent. ..	4·13	12·71	26·68	29·27	17·70	7·05	1·80	·47	·20	..	..
Mature ..	Number ..	172	508	1,242	1,499	980	409	103	29	4	1	..
	Per cent. ..	3·48	10·27	25·11	30·30	19·81	8·27	2·08	·59	·08	·02	..
Unknown ..	Number ..	785	2,249	4,086	3,768	1,771	546	136	32	6	1	1
	Per cent. ..	5·87	16·81	30·54	28·16	13·24	4·08	1·02	·24	·04	·007	·007
Total ..	Number ..	1,194	3,401	6,559	6,388	3,326	1,146	287	71	15	2	1
	Per cent. ..	5·34	15·19	29·29	28·35	14·85	5·12	1·28	·32	·07	·009	·004

Table 5 shows the number and percentage of cows in various butterfat ranges according to ages. It will be noted that of the 22,392 cows which completed their lactations, 4,597, or 20.5 per cent., produced less than 100 lb. butterfat. This is a matter which obviously merits the earnest thought of all engaged in dairying with a view to raising the yield of this proportion of unproductive cows.

Herd Averages.

When the recorded herds are grouped together it is noted that 10.5 per cent. of the herds averaged less than 100 lb. butterfat, as compared with 14 per cent. last year, while only 9·5 per cent. averaged over 200 lb. butterfat.

Table 6 shows the number and percentage of herds in the various butterfat production ranges for districts and for the State.

TABLE 6.

NUMBER AND PERCENTAGE OF HERDS IN VARIOUS BUTTERFAT PRODUCTION RANGES, 1949–50.

District.		Total Number of Herds.	Under 100 Lb.	100–149 Lb.	150–199 Lb.	200–249 Lb.	250–299 Lb.	Over 300 lb.
Eastern Downs ..	Number ..	186	14	75	77	19	1	..
	Per cent. ..	..	7·53	40·32	41·40	10·22	·54	..
Western Downs ..	Number ..	60	11	26	22	1	..	..
	Per cent. ..	..	18·33	43·33	36·67	1·67	..	..
South-eastern Queensland	Number ..	..	255	28	115	91	18	3
	Per cent. ..	..	10·98	45·10	35·69	7·06	1·18	..
Lower Burnett ..	Number ..	87	11	45	21	10	..	..
	Per cent. ..	..	12·64	51·72	24·14	11·49	..	..
Upper Burnett ..	Number ..	20	3	7	8	2	..	..
	Per cent. ..	..	15·00	35·00	40·00	10·00	..	..
Mackay	Number ..	10	1	7	1	1	..	..
	Per cent. ..	..	10·00	70·00	10·00	10·00	..	..
Atherton Tableland	Number ..	97	7	30	47	9	4	..
	Per cent. ..	..	7·22	30·93	48·45	9·28	4·12	..
All Queensland ..	Number ..	715	75	305	267	60	8	..
	Per cent. ..	..	10·49	42·66	37·34	8·39	1·12	..
All Queensland 1948–49	Number ..	507	71	228	152	38	17	1
	Per cent. ..	..	14·0	45·0	30·0	7·5	3·3	0·2

Mention has already been made of the large proportion of cows which fail to milk for 270 days (9 months). Cows which dry off in less than this time spend a considerable period in the paddock without profit to their owners. An article published in this Journal in September, 1950 and entitled "A Survey of Herd Recording Data" showed that because of the relationship between the length of the lactation period and the production of the animal, it is necessary for cows to milk for a full lactation period. It would appear that the length of lactation is affected by the standard of nutrition and also by the breeding of the animal. Unfortunately, it has been apparent in the Pure Bred Dairy Cattle Production Recording Scheme that many animals, recorded under favourable conditions, do not complete a lactation period of nine months and it is feared that animals from these strains and families may transmit the tendency to short lactation periods to their progeny.

The cows which completed their lactations in 1949-50 had an average lactation period of 223 days, as compared with 220 days in 1948-49.

The average length of lactation for each age group in each district is given in Table 7.

TABLE 7.

AVERAGE LENGTH OF LACTATION FOR EACH AGE GROUP ACCORDING TO DISTRICTS.

District.	2-year-old. Days.	3-year-old. Days.	4-year-old. Days.	Mature. Days.	Unknown Ages. Days.	All Cows. Days.
Eastern Downs ..	221	223	229	229	212	218
Western Downs ..	211	219	218	213	196	203
South-eastern Queensland	232	236	231	232	234	234
Lower Burnett ..	210	228	221	223	211	213
Upper Burnett ..	184	234	205	217	210	211
Mackay	210	223	213	219	195	218
Atherton Tableland	231	243	242	243	225	238
All Queensland ..	225	231	230	230	219	223

ANIMAL HEALTH

Parasitic Worm Diseases of Cattle.*

P. J. O'SULLIVAN (Parasitologist, Animal Health Station, Yeerongpilly.)

PARASITISM of cattle by worms is common and widespread throughout coastal and sub-coastal Queensland and occurs occasionally further inland. Mortality can at times be serious, but even greater losses result from the less obvious effects of infestation—namely, failure to grow, loss of condition, unthriftiness and susceptibility to other diseases. The cattle owner, and the dairy farmer in particular, should therefore be constantly on guard against outbreaks of parasitic diseases. These are not spectacular in their onset like some diseases caused by bacteria and in many cases the presence of worms is not suspected until the animals are noticeably ill.

Calves and yearlings suffer most severely, particularly in the dairying districts which receive high rainfalls and in which there is a comparatively heavy rate of stocking. Both these factors are favourable to the infestation of cattle by worms. Furthermore, the methods of calf-rearing adopted by many dairy farmers, whereby the calves are weaned almost from birth and thereafter raised in a most haphazard manner, produce very susceptible animals. Heavy infestations are seen also among young beef cattle, particularly in the coastal districts.

Outbreaks occur chiefly during the winter and early spring. Infestation, for the most part, takes place during the spring, summer and early autumn, but so long as the pastures remain green and nutritious, the infested animal usually holds its condition fairly well. As soon as the pastures begin to dry off, however, the animal's resistance to the worms is lowered and the ill-effects from the infestation become apparent.

HOW TO DETERMINE WHETHER AN ANIMAL IS SUFFERING FROM WORMS.

An animal whose health is affected by worms shows certain symptoms. Unfortunately these symptoms are not indicative of worms alone. Animals suffering from other debilitating diseases or malnutrition often have a "wormy" appearance.

The most common symptom of a heavy infestation is a gradual loss of condition. This is frequently accompanied by diarrhoea. The membranes lining the mouth and eyes may lose their healthy pink colour and become nearly white. The coat becomes dry and harsh and the animal has a dejected hide-bound appearance. Dropsical swellings under the jaw may be seen (bottle jaw) and the animal may become pot-bellied (Plate 160).

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* This article is a revision of an advisory leaflet written by Dr. F. H. S. Roberts, and issued by the Department in 1940.

Plate 160.

Calf Heavily Infested With Worms. Note its poor condition, rough coat, dull dejected appearance and the pronounced swelling under the jaws.

The most reliable method of diagnosis is to kill an affected animal and carefully examine the internal organs. This method is not always practicable, particularly if the herd is small and the animals are valuable.

In making an examination, the whole of the alimentary tract should be opened and thoroughly examined. The larger worms are readily seen moving in the ingesta or attached to the walls, but even heavy infestations of the smaller species may escape notice unless a very careful search is made. The walls of the stomach and the small intestines should be lightly scraped and the scrapings examined in a glass dish held over a dark background. The smaller stomach and intestinal worms can thus be readily detected. The worms infesting the caecum and large bowel are relatively large and can be easily seen with the naked eye. The lungs should receive attention and the windpipe and the smaller air tubes split open and examined.

Relatively few worms do little damage but when present in large numbers they may be serious. It must be remembered that the various species of worms differ in the degree of damage they are capable of causing, the most harmful species being those that suck blood. An infestation of 4,000 to 5,000 hair worms in the small intestines would not be serious, but 400 to 500 hookworms in the same location would do considerable harm. The number of brown stomach worms required to be harmful is very much greater than the number of large stomach worms. Under natural conditions a calf is usually infested with a number of species and even though the number of worms in each species may not be large the overall effects of the infestation may be serious.

If a count of the worms present is desired the fourth stomach, small and large intestines may be forwarded unopened to the Animal Health Station, Yeerongpilly. It is desirable to tie the fourth stomach off at each end with strong string and cover the specimen with 5 per cent. formalin (8 ounces of formalin to 1 gallon of water).

An indication of the degree of infestation can be obtained by means of an examination of the calf's dung. Individual samples are not always reliable because of variations in the number of worm eggs in

the dung from day to day. It is therefore advisable to send samples from a number of animals in the herd. The samples of dung should be placed in a 2 oz. screw-capped jar which is completely filled. The lids should be screwed down tightly to exclude any air and the samples forwarded as quickly as possible to the laboratory.

Advice should accompany all specimens as to the age of the animals, any clinical symptoms, condition of the pasture and any previous history relating to parasitism. It is desirable that all such samples should be forwarded through the local Stock Inspector or Veterinary Officer.

THE WORM PARASITES.

Many kinds of worms are capable of infesting cattle and causing disease. They are known collectively as helminths and consist of three main groups—trematodes or flukes, cestodes or tapeworms, and nematodes or round worms.

Worms do not breed inside an animal. The only way infestation can occur is through an animal picking up minute larval worms from the pasture as it grazes. These tiny larval worms (less than one-thirtieth of an inch long) arise from eggs laid by female worms

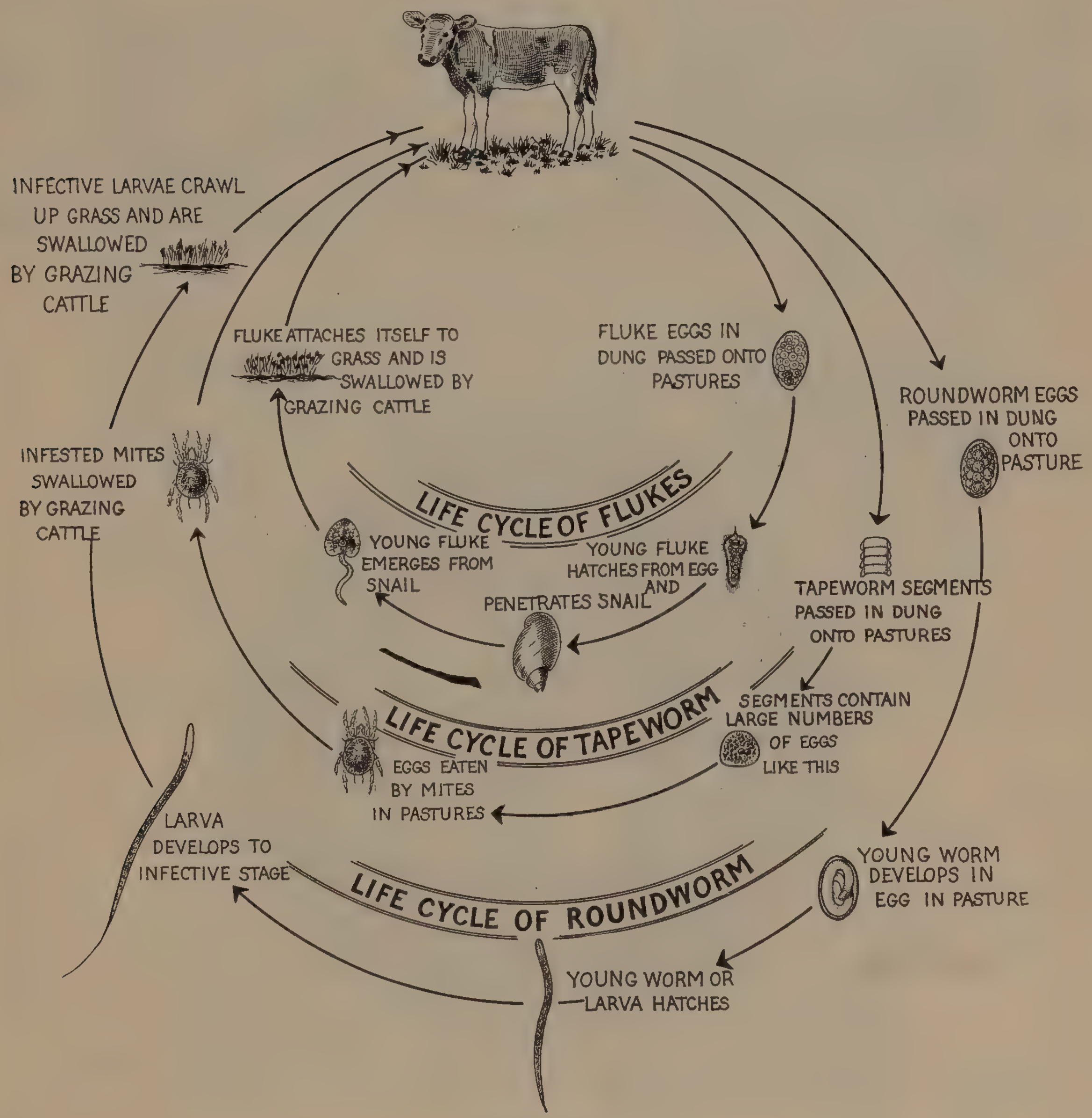


Plate 161.

Diagram Showing How Cattle Become Infested With Various Types of Worms.

living in the animal and passed out in the animal's dung. The small white to reddish worms often seen in drinking troughs, swamps or damp areas are not parasitic and are incapable of infesting stock.

With some kinds of worms—flukes and tapeworms, for example—the larval worms must undergo a necessary part of their development in a snail or some other animal before they can infest their final host. The snail or other animal in which the larva develops is called an intermediate host.

The life cycles of various parasites are shown diagrammatically in Plate 161.

TREMATODES OR FLUKES.

These are usually moderate sized worms, either flat and leaf-like or conical in shape. They are usually hermaphrodite—that is, each fluke contains a complete set of male and female organs. The flukes of cattle can complete their life cycle only when certain species of snails are present in which the larval form develops.

The eggs when laid by the fluke pass out of the animal in the manure. Should they fall into water, development proceeds and the eggs eventually hatch to give rise to a tiny larval fluke. This larval fluke swims in the water for a short time and finds a suitable snail into which it burrows. After spending a period of growth in the snail, the young fluke, now known as a cercaria, makes its way into the open again and attaches itself to the grass near the surface of the water. It secretes a protective covering round itself and can remain alive in this encysted state for long periods, even though the water level may fall below the cyst. Cattle swallow these larval flukes while grazing on swampy areas.

Plate 162.

Liver Fluke (*Fasciola hepatica*). Natural size.

Liver Fluke (Fasciola hepatica).

The adult liver fluke (Plate 162) is a flat leaf-like worm, pinkish to pale brown in colour and up to 1½ inches long. It is found in the bile ducts of the liver of sheep and cattle and more rarely of other animals.

Life History.—The life cycle is similar to that outlined above. When the young fluke is ingested by cattle it burrows through the intestinal wall and makes its way to the liver. It wanders in the liver for a month or more before it reaches the bile ducts. The flukes commence to lay eggs two to three months after being ingested.

Two groups of snails are found along the edges of creeks, soaks and swampy areas and can be separated as follows. If the snail is placed with the opening of the shell downwards and the point of the shell towards the observer, the group containing the liver fluke snail has the spiral of the shell coiled in a right hand or clockwise direction and the basal opening of the shell is on the right. The second group, which includes the majority of the larger common freshwater snails, has a left hand or anti-clockwise spiral and the basal opening of the shell is on the left. Such snails do not carry liver fluke.

Plate 163.

Freshwater Snails. Upper left, stomach fluke snails; upper right, liver fluke snails; lower right and left, common freshwater snails which do not carry flukes.

The liver fluke snail of Australia (*Simlimnea brazieri*) is greenish-black to yellowish-brown in colour and has broad, triangular, ear-shaped tentacles. In size it varies from one-twelfth of an inch when newly hatched up to a maximum of a quarter of an inch when mature. The other freshwater snails with right hand spirals are larger than the fluke snail (Plate 163) or have long thin tentacles resembling those of garden snails.

Fluke Disease.—In Queensland, fluke disease of cattle is known to occur only in two small areas—one around Stanthorpe, which is an extension of the fluke areas of the Northern Tablelands of New South Wales, and another in the valley and watershed of the Mary River.

Mature cattle appear to be little affected, for despite the presence of flukes they usually hold their condition fairly well. The parasites can, however, be serious in young cattle, causing unthriftiness, loss of condition, diarrhoea and death. In advanced cases the tissues of the mouth and eyes are pale and a swelling is present under the jaws ("bottle jaw"). Aged animals are sometimes seen suffering from a chronic type of fluke disease which is denoted by wasting and scouring.

An important source of loss is the condemnation of livers at abattoirs through fluke damage. A fluky liver has an enlarged and mottled appearance. The bile ducts are thickened and impregnated with lime and stand out as white tubes above the surface of the liver. This appearance gives the infested liver the popular name of "pipey" liver.

Treatment and Control.—Carbon tetrachloride is used successfully for treating fluke disease in sheep, but unfortunately it is a rather risky drug to give to cattle. It may be administered with a fair degree of safety to calves and yearlings but should never be used for adult cattle. The dose for young animals is 2-5 cubic centimetres according to weight, given in a small quantity of liquid paraffin.

Hexachloroethane is efficient and is probably safer to use in cattle than carbon tetrachloride. This drug is not soluble in water but is available as a wettable powder that can be suspended in water and given as a drench. The dose rate of the powder is as follows:—

Animals less than 6 months	½ oz.
6 to 12 months	¾ to 1 oz.
12 to 18 months	1 to 1½ oz.
over 18 months	2 oz.

Infestation of cattle can be prevented by destroying the snail intermediate host. This may be accomplished by carrying out the following recommendations:—

(1.) Marshland, bogs, backwaters from creeks, etc., should be drained and kept as dry as possible. The banks of creeks should be kept free of weeds and debris to facilitate the flow of water.

(2.) Bluestone in very minute amounts is very poisonous to snails, and it may be applied in the following ways to bog lands, creeks, and other places where snails live:—

(*a*) With pools and other still waters, tie a bag to the end of a pole and drag it backwards and forwards through the water until the water has a faint blue tinge. In the case of a slow running stream, suspend a bag of bluestone at intervals along its length.

(*b*) For boggy, marshy areas, broadcast a mixture of finely ground bluestone and sand (1 to 4) at a rate of 20 lb. of bluestone per acre.

To be most effective, bluestone should be used during the early part of the months of June and December. Drainage of swamps without the use of bluestone is not effective, for in wet periods the waters spread over from the drains and create suitable conditions for large-scale breeding by snails. Drainage of swamps is desirable in that it confines the water to certain well defined areas that can be easily treated with bluestone.

Conical or Stomach Fluke (Paramphistomidae).

These are pinkish, pear-shaped worms (Plate 164) which in the adult stages are attached to the walls of the paunch and honeycomb. They are extremely common in cattle in the coastal and sub-coastal areas of the State and are frequently seen in very large numbers. The conical flukes of Queensland consist of several species but can be conveniently dealt with as a single group.

Life History.—The life history of a conical fluke is similar to that of the liver fluke but a different species of snail in involved. The snails concerned are small and flat with the coils all in the same plane, and shaped like a ram's horn (Plate 163). They are one-eighth to three-sixteenths of an inch in diameter and vary in colour from greenish to blackish-brown.

Plate 164.

Conical Fluke. Top, young flukes from the small intestine; bottom, adults from the paunch and honeycomb.

After being swallowed by the animal the young flukes make their way to the small intestine and attach themselves to its wall. Finally the parasites return to the paunch and honeycomb, where they grow to the adult stage.

Effect on Cattle.—The adult flukes in the paunch and honeycomb, even when present in large numbers, are not considered very harmful. During the time these parasites are present in the small intestines, however, they are capable of causing serious damage. The intestinal wall becomes very inflamed and the animal is afflicted with a severe diarrhoea, the excreta being dark in colour and evil smelling. Affected animals, particularly young stock, lose condition and grow weak.

Treatment and Control.—No effective treatment for infested cattle is known and control depends on the prevention of infestation. The snail vectors may be destroyed by the measures advised for the control of liver fluke.

CESTODES OR TAPEWORMS.

Tapeworms are elongate, flat, creamy worms, which in cattle attain a length of up to 15 feet. The tapeworm has a tiny head provided with suckers with which it attaches itself to the wall of the intestine. A slender neck connects the head to the body of the tapeworm. The body is composed of a number of short, flat segments, which become progressively broader towards the posterior end of the worm. Tapeworms, like flukes, are hermaphrodites and each segment contains a complete set of male and female organs. The segments are formed in the neck region and become more mature the further removed they are from the head. At the posterior end of the worm they may be completely filled with eggs.

When the eggs in the terminal portions of the tapeworm have reached a certain stage in their development the "ripe" segments drop off the body of the worm and pass out with the manure. These ripe segments then break up, freeing large numbers of eggs. The egg must then be eaten by some other animal such as an insect, mite, etc., before it can develop further. Inside this intermediate host the egg hatches and gives rise to a tiny larval tapeworm. Should this larval tapeworm, or the intermediate host containing it, be eaten by a susceptible animal, the larval tapeworm settles down in the intestine and eventually grows to the adult stage.

Cattle not only harbour adult tapeworms but also act as an intermediate host for some tapeworms of the dog and man.

Larval Tapeworms.

Two kinds of larval tapeworms are commonly found in Queensland cattle. They are *Cysticercus tenuicollis* (water ball) and *Echinococcus granulosus* (hydatid cyst). A third species, *Cysticercus bovis,* has been recorded but is rare.

Cysticercus tenuicollis (Water Ball).—This larval tapeworm has the appearance of a ball of fluid with an opaque white centre which is the future tapeworm head. The cyst generally hangs suspended by a short neck in the caul fat or elsewhere in the abdominal cavity. If this cyst is eaten by a dog, the tapeworm is liberated and grows to maturity. The adult tapeworm in the dog is known as *Taenia hydatigena.*

Echinococcus granulosus (Hydatid Cyst).—Hydatid cysts occur most commonly in the liver and lungs, though other organs may be involved. They consist of bladders of fluid containing numerous small white specks. These specks are the heads of the future tapeworms. If a cyst is eaten by a dog it will give rise to large numbers of adult tapeworms known as *Taenia echinococcus.* These tapeworms are very small, never more than a quarter of an inch long.

Man, as well as cattle, sheep, pigs, etc., may act as an intermediate host of this tapeworm and hydatid cysts in the liver and lungs of man are responsible for a very serious disease. Infested dogs generally get their coat contaminated with eggs and people handling and fondling these animals are very likely to acquire an infestation.

To guard against the spread of hydatids, no raw offal, particularly lungs, heart, liver or spleen, should be fed to dogs. Offal can be rendered quite safe if placed in boiling water for 10 minutes. Fortunately, a large proportion of the hydatid cysts in cattle are sterile (no tapeworm heads in the bladder), so the risk of infection is not so great as with sheep offal. However, a single viable cyst is capable of setting up an infestation in a dog.

The adult tapeworm can be removed by starving the dog overnight and giving a dose of arecoline hydrobromide next morning. The dose rate of this drug is one-eighth of a grain for every 10 lb. bodyweight of the dog. This drug produces a violent purge in 20 to 30 minutes and removes any tapeworms and eggs present. This and subsequent motions should be carefully collected and burnt.

Cysticercus bovis (''Beef Measles'').—These are small cysts (half an inch by a quarter of an inch), surrounded by a strong fibrous capsule, lying in the muscles of the animal. They occur chiefly in the muscles of the jaw, heart, diaphragm and shoulder but may occur in other parts of the body.

The adult tapeworm is *Taenia saginata,* the so called ''unarmed'' tapeworm of man. Human infestation occurs from eating raw or improperly cooked beef. Fortunately, this tapeworm is very rare in Queensland.

Adult Tapeworms.

Three different species of adult tapeworms infest cattle in Queensland. They are very similar in appearance; the most common species is *Moniezia benedeni* (Plate 165).

Life History.—The intermediate host of these tapeworms is a tiny mite which occurs commonly in pastures, particularly in damp areas. The mites become infested with larval tapeworms when they swallow eggs passed in the manure. Should an infected mite be swallowed by cattle, the tapeworm larva settles down in the small intestines, where it grows to the adult stage.

Effects on Cattle.—Very little is known of the effects of tapeworms in cattle. As a rule these parasites occur only in young animals and it is considered that many well-grown worms must be present before any symptoms of ill health are noticeable.

Tapeworm infestation is denoted by the passage of creamy to white segments in the dung. Tapeworm infestations are generally of short duration, so treatment for these worms is usually not required. Before drenching for tapeworms the cattle owner should make sure that the poor condition of the animals is not due to other more harmful worms such as stomach worms, hookworms or large bowel worms.

Treatment and Control.—Tapeworms can be removed by an arsenical drench. A formula for this drench is as follows:—

White arsenic (95-99 per cent. arsenious acid) ..	2 oz.
Epsom salts	6 lb.
Water	2½ gallons

Boil the arsenic slowly in two gallons of water for half an hour. Allow the sediment to settle; then pour off and retain the clear fluid, discarding the sediment. Add the Epsom salts, stirring well till

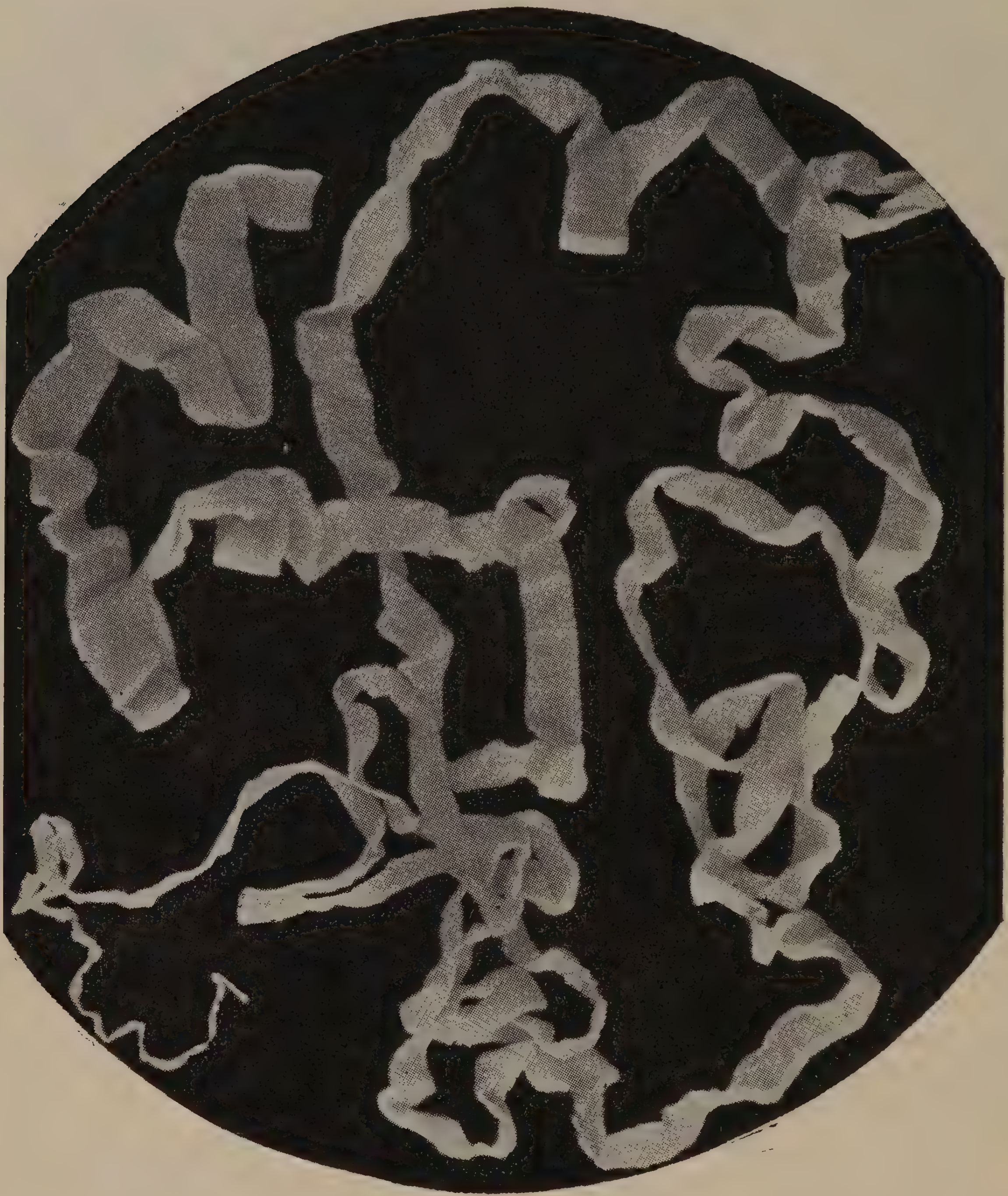


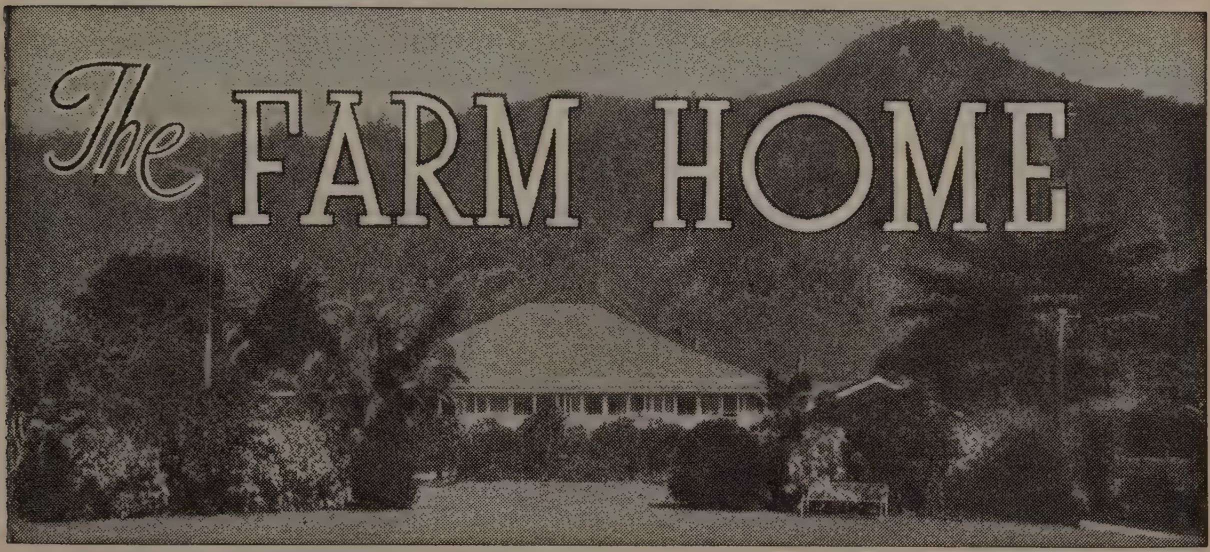
Plate 165.

Tapeworm (Moniezia benedeni). Natural size.

dissolved, and then make up to 2½ gallons with water. Calves should be given 1½ to 3 fluid ounces of this mixture according to their age. No starvation is necessary, but water should not be permitted till about four hours after drenching.

When small numbers of animals are to be treated it is more convenient to purchase a prepared arsenical drench than to make up the above on a reduced scale. On a farm it is difficult to weigh and measure small quantities, and unless arsenical drenches are carefully prepared, poisoning may result.

[TO BE CONTINUED.]



Child Development.

THE parents of today are overwhelmed with a deluge of science, statistics, standards and averages and consequently tend to develop phobias about what is normal in their children and what is not. The natural instincts, the normal rhythms of life, the art of mothercraft and the joy of children are in danger of being swamped in a sea of scientific facts and figures.

How many mothers worry unnecessarily about their child's physical and mental development because the child has not reached some arbitrary standard of weight or activity by a certain date, even though the child may obviously be in perfect health and as happy as the day is long.

There is such immense diversity in children, so many different factors to be taken into account, that even averages, weight curves, &c., cannot always provide a suitable standard by which to judge individual children. Take growth and weight for instance. Here the difficulty arises from the fact that although many of us can say what the average weight and height is for a child of a given age and sex, none can say what the normal is. A child may be pounds below the average in weight and inches below the average in height, and yet be perfectly normal. On the other hand, a child may be quite up to the average in weight and height and yet have severe organic disease, even including a vitamin deficiency.

Physical development is affected by a variety of factors other than disease. Some of these factors are discussed here.

One would expect the children of small parents to be smaller than those of large parents. Also some children in some families have a characteristic rhythm of growth whereby they remain small for the first few years of life and subsequently catch up to their fellows.

Another factor affecting the development of the child is his size at birth. One authority on child health has demonstrated that, in general, the larger the child at birth, the larger will he be in weight and height in the remaining years of childhood up to puberty, and vice versa.

Then there are psychological factors. We all know the thin wiry build of the highly active nervous type of child, and the plump rather stocky build of the placid easy going child.

It should be realised that children are of different shapes and different sizes and that they mature at different rates (both physically and mentally) and that more important than mere weight and height are the child's general wellbeing, contentment, abundant energy, muscle tone, freedom from lassitude and freedom from infection.

These cannot be achieved by trying to compel the child to take more food or more sleep, nor by over-protection. For example, in the weaning period the child is particularly apt to be difficult about new foods and if the mother has been worried about her child being rather under-nourished or under-sized she is apt to try to force the child to eat, and it is disastrous to try and force babies to eat.

In the stage from one to two years a child characteristically dawdles with his food; he plays about and superficially seems to have no appetite. He will get over it if he is left alone. If he is forced to eat, the resultant food refusal leads to the opposite of the effect desired. In later years the problem of food refusal is extremely common; almost invariably it is due to food-forcing methods which so often result from undue anxiety about a child's weight, height and nourishment.

Similarly, with mental and intellectual development there are wide variations in the normal maturation rates. Whereas, for instance, the average age of commencement of walking is approximately 15 months, it may be at any time between nine months and two years; moreover, anything between those limits is normal. The same is true of weaning, talking and independence; in all these functions the variation in small children is enormous.

Toilet training is another matter which causes much undue worry and distress. Many young mothers today live in the illusion that children of 18 months are dry. It is not true, for at this age almost every child is wetting his bed and even at the age of three, one child in five will still be wetting his bed. That may be inconvenient but there is nothing abnormal about it.

So you see there are many pitfalls and fallacies in the too strictly scientific and rigid interpretation of child development. Provided your child appears to you to be well, healthy, active and contented there is not likely to be much wrong with him; so don't fuss and fret over him—let him develop in his own individual way and according to the natural laws and rhythms of Nature. If you try to force the pace, you will be courting disaster.

What you can and must do is to give him love and security, wise upbringing and wise discipline—a healthy clean environment, protection against accidents and infectious diseases and a good varied nourishing diet.

Enjoy your children and let them enjoy life too.

Any further information on this and other matters connected with children may be obtained by communicating personally with the Maternal and Child Welfare Information Bureau, 184 St. Paul's Terrace, Brisbane, or by addressing letters "Baby Clinic, Brisbane." These letters need not be stamped.

Brucellosis Testing of Swine.

The Department of Agriculture and Stock is operating a scheme whereby pig herds are tested at intervals for the occurrence of swine brucellosis (contagious abortion).

A herd listed by the Department as "brucellosis tested" is one in which all such animals as may be determined by the Director of the Department's Division of Animal Industry have been subjected to two successive tests for brucellosis, at intervals determined by him, without any positive reactors being found.

In order for a herd to be retained on the list of Tested Herds, a semi-annual or annual re-test of the herd, as determined by the Director, is required. If at a re-test any animal gives a positive reaction to the test the herd is removed from the list; it is not listed again until subsequent tests, as determined by the Director, have been carried out.

Full particulars of the Brucellosis Testing of Swine and application forms may be obtained from the Under Secretary, Department of Agriculture and Stock, William Street, Brisbane.

TESTED HERDS.
(AS AT 22nd OCTOBER, 1951.)

Breed.	Owner's Name and Address of Stud.
Berkshire	S. S. Ashton, "Scotia" Stud, Pittsworth J. J. Bailey, "Lucydale" Stud, East Greenmount S. Cochrane, "Stanroy" Stud, Felton Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield G. Handley, "Handleigh" Stud, Murphy's Creek J. L. Handley, "Meadow Vale" Stud, Lockyer R. G. Koplick, "Melan Terez" Stud, Rochedale H. V. Littleton, "Wongalea" Stud, Crow's Nest O'Brien and Hickey, "Kildurham" Stud, Jandowae East E. Pukallus, "Plainby" Stud, Crow's Nest G. C. Traves, "Wynwood" Stud, Oakey E. Tumbridge, "Bidwell" Stud, Oakey Westbrook Farm Home for Boys, Westbrook H. W. Wyatte, Rocky Creek, Yarraman H. M. State Farm, "Palen Creek," Palen Creek A. R. Ludwig and Sons, "Cryna" Stud, Beaudesert H. H. Sellars, "Tabooba" Stud, Beaudesert F. Thomas, "Rosevale" Stud, Beaudesert Bowkett and Meacle, "Myola Vale" Stud Piggery, Burra Burri, Jandowae D. T. Law, Trouts Road, Aspley R. J. McCullough, "Maxholm" Berkshire Stud, Gatton C. F. W. and B. A. Schellback, "Redvilla" Stud, Kingaroy R. H. Crawley, "Rockthorpe" Stud, *via* Pittsworth
Large White	H. J. Franke and Sons, "Delvue" Stud, Cawdor Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield F. L. Hayward, "Curyo," Jandowae J. A. Heading, "Highfields," Murgon K. B. Jones, "Cefn" Stud, Pilton R. G. Koplick, "Melan Terez" Stud, Rochedale R. Postle, "Yaralla" Stud, Pittsworth E. J. Bell, "Dorne" Stud, Chinchilla M. E. Myers, Halpine Plantation, Kallangur L. C. Lobegeiger, "Bremer Valley" Stud, Moorang, *via* Rosewood J. H. G. Blakeney, "Talgai" Stud, Clifton V. P. McGoldrick, "Fairymeadow" Stud, Cooroy N. Woltmann and Sons, Wooroolin

TESTED HERDS—continued.

Breed.	Owner's Name and Address of Stud.
Tamworth	S. Kanowski, "Miecho" Stud, Pinelands
	N. R. Potter, "Actonvale" Stud, Wellcamp
	D. F. L. Skerman, "Waverley" Stud, Kaimkillenbun
	A. C. Fletcher, "Myola" Stud, Jimbour
	L. C. Lobegeiger, "Bremer Valley" Stud, Moorang, *via* Rosewood
	P. V. Campbell, Lawn Hill, Lamington
	Salvation Army Home for Boys, Riverview
	F. Thomas, "Rosevale" Stud, Beaudesert
	A. J. Surman, Noble Road, Goodna
	P. V. McKewin, "Wattleglen" Stud, Goombungee
	Department of Agriculture and Stock, Regional Experiment Station, Kairi
Wessex Saddleback ..	W. S. Douglas, "Greylight" Stud, Goombungee
	K. Day and P. Hunting, "Kazan" Stud, Goodna
	E. Sirrett, "Iona Vale" Stud, Kuraby
	C. R. Smith, "Belton Park" Stud, Nara
	H. H. Sellars, "Tabooba" Stud, Beaudesert
	H. Thomas, "Eurara" Stud, Beaudesert
	D. T. Law, Trouts Road, Aspley
	G. J. Wilson, "Glenbella" Stud, Silverleigh
	G. J. Cooper, "Cedar Glen," Yarraman
	J. B. Dunlop, Acacia Rd., Kuraby

The 1950 Queensland Year Book.

The eleventh issue of the Queensland Year Book just issued by the Government Statistician contains statistics for the State up to 1949 and has a number of new features on marketing, geography, irrigation, water conservation and other subjects of interest to primary producers and others.

The Year Book is available from the main bookstores or from the Government Statistician's office at the prices of two shillings for paper-covered copies and three shillings for cloth-covered copies.

The Government Statistician has also available, free of charge, the 1951 issue of the Queensland Pocket Year Book, which contains statistics up to 1950 on a variety of subjects.

Certificate Course In Agricultural Science.

Enrolments for 1952 in the Certificate Course in Agricultural Science being conducted by the University of Queensland should be completed by the beginning of February. Full details of the course are obtainable from the Brisbane Technical Correspondence School, Melbourne street, South Brisbane, which handles the enrolments for the University.

ASTRONOMICAL DATA FOR QUEENSLAND.

DECEMBER.

Supplied by W. J. Newell, Hon. Secretary of The Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			Minutes Later than Brisbane at Other Places.					
Day.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	4·45	6·28	Cairns	51	7	Longreach	44	26
6	4·46	6·32	Charleville	30	24	Quilpie	33	37
11	4·47	6·35	Cloncurry	65	35	Rockhampton	19	0
16	4·49	6·38	Cunnamulla	27	32	Roma	19	15
21	4·51	6·41	Dirranbandi	16	22	Townsville	42	8
26	4·54	6·43	Emerald	28	11	Winton	52	29
31	4·56	6·46	Hughenden	49	2	Warwick	2	6

TIMES OF MOONRISE AND MOONSET.

At Brisbane.

Day.	Rise.	Set.
	a.m.	p.m.
1	6·23	9·05
2	7·34	9·58
3	8·45	10·44
4	9·54	11·23
5	10·58	11·57
6	11·59	..
	p.m.	a.m.
7	12·58	12·29
8	1·56	12·58
9	2·53	1·31
10	3·52	2·04
11	4·50	2·40
12	5·48	3·21
13	6·43	4·05
14	7·35	4·55
15	8·21	5·48
16	9·03	6·44
17	9·39	7·39
18	10·12	8·35
19	10·42	9·29
20	11·10	10·23
21	11·39	11·17
		p.m.
22	..	12·12
	a.m.	
23	12·09	1·10
24	12·42	2·11
25	1·19	3·17
26	2·04	4·27
27	2·57	5·37
28	3·59	6·44
29	5·10	7·44
30	6·23	8·34
31	7·35	9·18

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

Charleville 27; Cunnamulla 29; Dirranbandi 19;
Quilpie 35; Roma 17; Warwick 4.

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Day.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	9	30	25	45	0	21	26	53
6	18	19	33	35	9	10	38	40
11	29	12	44	26	19	1	52	29
16	29	10	44	25	19	0	52	28
21	19	19	35	36	10	10	41	41
26	29	10	44	24	19	0	52	27
31	26	14	43	29	18	4	50	33

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	56	3	68	32	52	18	46	4
3	50	11	64	38	48	23	41	11
5	38	23	56	45	41	30	32	20
7	27	23	48	45	33	30	22	20
9	16	39	41	57	26	42	14	34
11	7	49	36	63	20	49	7	41
13	2	55	33	67	17	52	3	45
15	5	55	35	67	19	52	5	45
17	11	49	38	63	23	49	10	41
19	20	40	44	58	29	43	18	34
21	30	31	51	51	35	36	25	26
23	35	19	54	43	39	28	29	17
25	46	8	62	36	47	21	38	8
27	55	2	68	32	51	17	45	3
29	55	5	68	34	51	20	45	6
31	46	15	62	41	47	26	38	14

Phases of the Moon.—First Quarter, December 6th, 2.20 a.m.; Full Moon, December 13th, 7.30 p.m.; Last Quarter, December 22nd, 12.37 a.m.; New Moon, December 28th, 9.43 p.m.

On December 23rd at 2 a.m. the sun will reach its greatest angle south of the Equator and on the 7th and 21st the moon will rise and set approximately at true east and true west respectively.

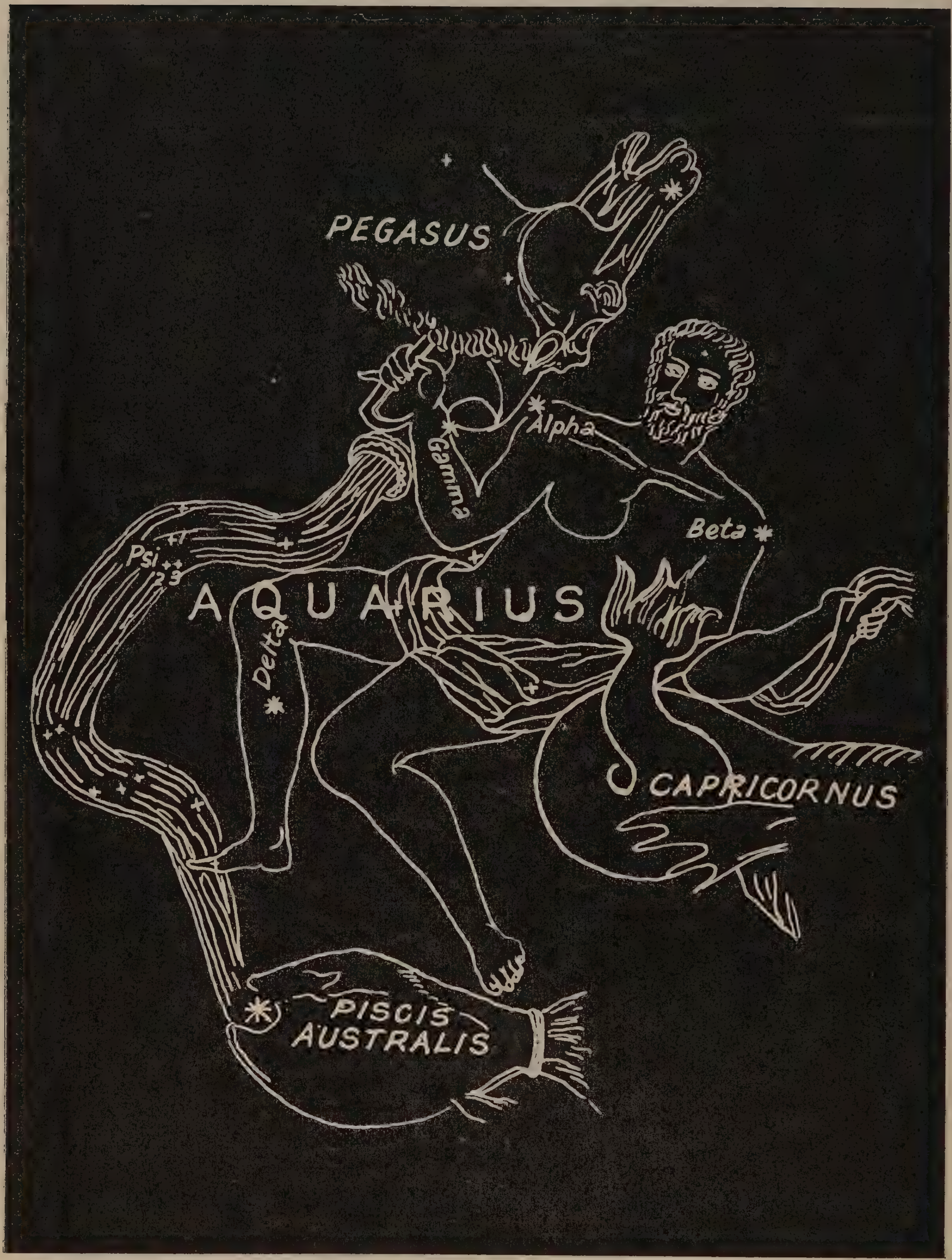
Mercury.—An evening object at the beginning of the month when in the constellation of Sagittarius it will set 1¾ hours after the sun. After the 7th it will move westward among the stars and by the end of December will again be in the constellation of Ophinchus, when it will rise about 1½ hours before sunrise.

Venus.—Now a conspicuous object in the east during morning twilight. At the beginning of the month, not far from Spica in the constellation of Virgo, it will rise 2 hours 24 minutes before the sun and by the end of the month, in the constellation of Libra, it will rise 2 hours 42 minutes before sunrise.

Mars.—In the constellation of Virgo, will rise between 1.15 a.m. and 2.30 a.m. at the beginning of the month and on the 19th will pass very close to Saturn. At the end of the month it will rise about midnight.

Jupiter.—Will set near midnight during December.

Saturn.—Situated near Mars in the early morning sky. It is, however, brighter than Mars and will rise between 1.45 a.m. and 3 a.m. at the beginning of the month and about midnight at the end of the month.



THE CONSTELLATIONS.

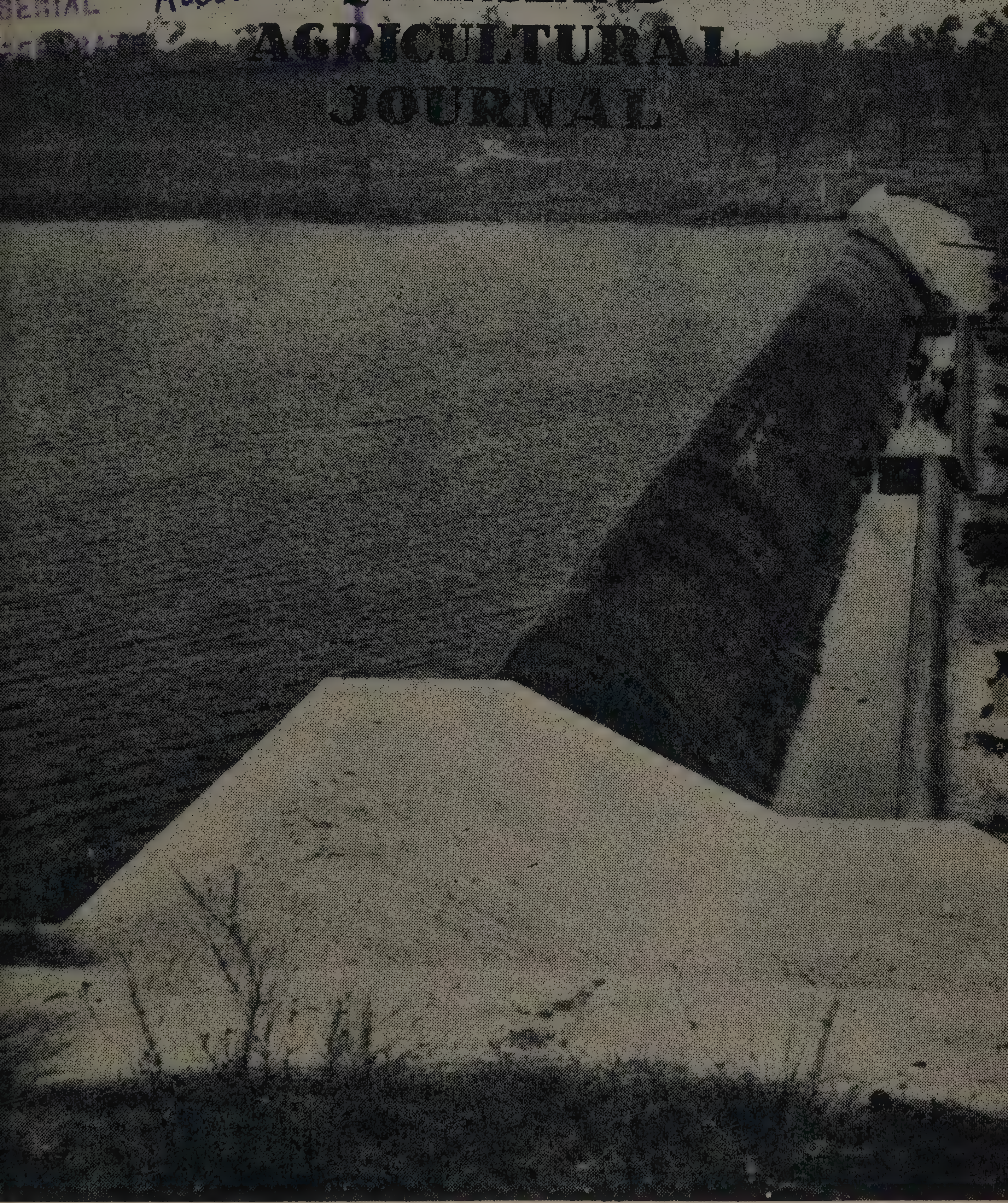
AQUARIUS.

Situated between the constellations of Piscis Australis and Capricornus (described in February, 1951, Journal) and the constellation of Pegasus (described last month) is the constellation of Aquarius, the Water Carrier. It is one of the Zodiacal constellations. It stretches along the ecliptic or path of the sun for about 50 degrees and extends about 45 degrees in a north-south direction. It thus covers a very large portion of the sky but it is not very conspicuous, having only three stars as bright as 3rd magnitude. They are Alpha (known as Sadalmelik or Sadalmulk), Beta (known as Sadalsud or Sadalsund) and Delta (known as Skat, Sheat or Scheat), Gamma, a 4th magnitude star, is known as Sadachbia. Old star maps show Aquarius as a man pouring water from an urn into the mouth of Piscis Australis, and Psi 1, 2 and 3 is an interesting little group which along with others which can be seen with binoculars is situated in the stream pouring from the urn.

VOL. 73. PART 6 DECEMBER, 1951

DEPARTMENT OF AGRICULTURE

QUEENSLAND AGRICULTURAL JOURNAL



The Bruce Weir on the W
River, North Queenslan

LEADING FEATURES

Tropical Pasture Investigations

Phoma Rot of Tomatoes

Strawberry Growing

Dairy Equipment Competition

Parasitic Worm Diseases of Cattle

Registered at the General Post Office, Brisbane, for transmission by Post as a Newspaper.

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Edited by
C. W. WINDERS, B.Sc.Agr.

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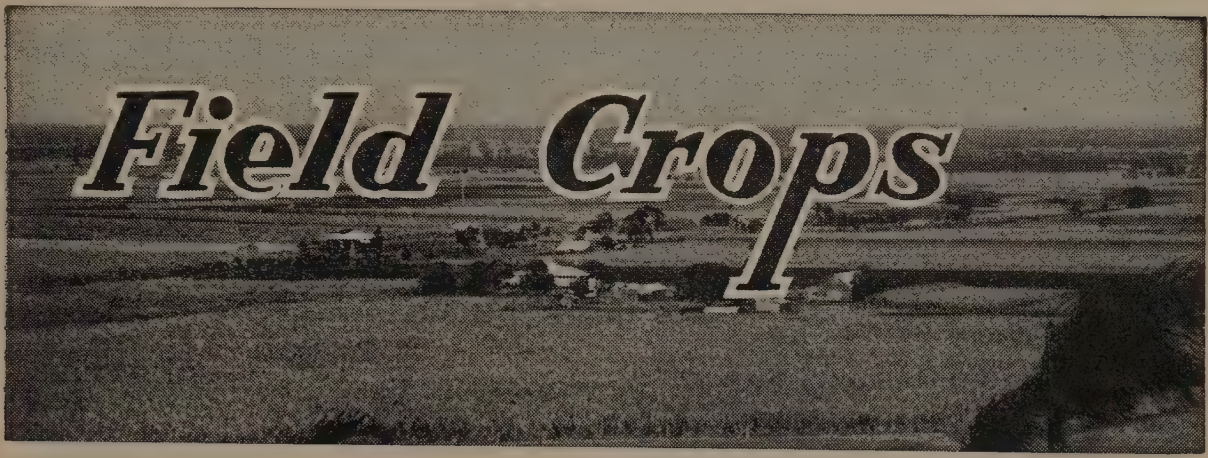
Contents



Tropical Pasture Investigations.

T. G. GRAHAM, Agrostologist, Agriculture Branch.

THE sugar growing industry is firmly established on the arable lands of the coastal belt north of Townsville, but the establishment of other primary industries in the area would be desirable from many points of view. Tobacco growing is making progress in the Ingham area and there is a small amount of other agricultural and horticultural production from centres scattered along the northern coastal belt.

For a number of years the Bureau of Tropical Agriculture at South Johnstone has been experimenting with various tropical crops which may have commercial prospects on the wet coastal lands. Among these crops are tea, rice and fibre plants, but much remains to be investigated before the stage of economic production of these crops is reached. The main activity at the Bureau, however, has been the investigation of suitable tropical pastures.

The possibilities of using pastures to fatten beef cattle on the northern coastal and sub-coastal districts have attracted attention for some time and there are indications that the development of suitable tropical pastures can offer practical prospects of using country in this area which is not suitable for cultivated crops. Much of the area has an abundant rainfall for upwards of nine months of the year and, if good tropical pastures could be grown, an excellent outlet would be provided for fattening cattle from the breeding areas of the adjoining north-western country.

It had already been shown that stores could be brought in from the larger holdings and fattened under intensive grazing conditions on the coast, as was done for example on properties in the Daintree River area, in the venture by the late Mr. Brice Henry and in the coastal fattening experiments carried out by the Department of Agriculture and Stock on Mr. Henry's property at ''Riversdale'' in the Tully area. These experiments showed clearly that cattle could be topped off within a year on introduced pastures. It still remained to be proved, however, whether the pastures would stand up to grazing and whether they could be improved in any way. There was also the question of management and the part that it played in maintaining the sward and increasing the output.

Plate 166.

Grass and Legume Observation and Seed Increase Plots, Bureau of Tropical Agriculture.

In addition to examining tropical pastures for beef cattle fattening, there is also the problem of deteriorated pastures and declining production in the dairying areas on the East Palmerston. This decline has been due in large measure to the failure of the pastures under the form of management practised on them.

VALUE OF LEGUMES.

The limiting factor in dairying pastures in the tropical coastal areas, as in most other dairying areas of Queensland, is the absence of a legume, either native or introduced, which will grow in association with the grasses and provide a source of protein when the grasses decline during the late spring and early summer months. Moreover, a suitable grass-legume mixture would assist very materially to maintain soil fertility and so promote the maintenance of a good permanent pasture.

Preliminary investigations into tropical pasture species had been carried out at the Bureau of Tropical Agriculture for some years prior to 1946, but in that year it was decided to take an important step forward in the investigations by introducing beef cattle on to a series of plots in which stands of what were then considered the most promising pasture species and combinations of species had been established. The primary purpose of this move was to examine the behaviour of the various species under stocking. It was also hoped, by measuring the body weight gains of the animals, to get a sound indication of stocking capacities and nutritive qualities of the species and combinations of species under test. To date, however, the main emphasis has been placed on the examination of the reaction of the pastures to grazing.

Research has been in progress since the establishment of the Bureau of Tropical Agriculture to find suitable legumes which will grow under tropical conditions. By the end of 1942, it was fairly well established that a number of legumes would grow and survive against competition in this locality. Little was known, however, of their palatability or of their place in a pasture mixture with one or other of the permanent pasture grasses available for trial. These grasses—Guinea grass (*Panicum maximum* var. *typica*), molasses grass (*Melinis minutiflora*) and para grass (*Brachiaria purpurascens*)—existed in pure stands without association with any legume.

PALATABILITY TRIAL.

After considerable initial work, six of the most promising legumes were selected and placed in a palatability trial. This trial consisted of 18 plots each about one-tenth of an acre in area, providing for three replications of each variety and making a total area of approximately two acres. From the results of grazing for three days continuously at 25-day intervals over a period of three years, it has been shown that puero (*Pueraria phaseoloides*), Dolichos (*Dolichos hosei*), stylo (*Stylosanthes gracilis*), centro (*Centrosema pubescens*), and Desmodium (*Desmodium heterophyllum*) are palatable to stock in approximately that order, while calopo (*Calopogonium mucunoides*) is only slightly palatable. Of these, puero and Dolichos are eaten at any stage of maturity. At certain times of the year stylo and centro are eaten more readily than at other times. This coincides with the mature stage of the plant and also with the decline in the protein level of the grasses.

With stylo and centro, and indeed with most of the tropical perennial legumes, it seems more likely that animals accustomed to grazing the soft flush growth of grasses are not anxious to graze harsher plants while their requirements can be met from the grasses alone. But as soon as the grasses show signs of becoming harsh and dry during the drier months of September, October, and November, they turn to the legumes to balance their diet. It seems also that animals have first to become accustomed to the legumes before they will take to them readily.

PASTURE MIXTURE TRIALS.

In 1946 four pasture mixtures in two-acre blocks were laid down at the Bureau.

There were at this time four grasses and four legumes with ample seed supplies from which to choose. The grasses were para grass, Guinea grass, purple top Guinea grass (*Panicum maximum* var. *coloratum*) and molasses grass, and the legumes were stylo, centro, puero and calopo. Para grass was known to be unsurpassed in the wetter localities but no legume was known which would grow in a similar environment. Moreover, as the area for which early information regarding pasture mixtures was required included the hilly Palmerston dairying lands on which molasses grass was known to do well, and for which the Guinea grasses seemed promising, it was decided to concentrate on molasses grass, Guinea grass and purple top Guinea grass in the initial pasture mixtures. The grass-legume mixtures were selected according to their habits of growth, and the treatments chosen were Guinea grass and stylo, purple top Guinea grass and centro, molasses grass and puero, and molasses grass and calopo.

By the middle of 1946 these pastures were well established and the fencing completed. In August of the same year eight Hereford steers were purchased as two-year-olds and the grazing experiments began. Including the palatability trial there were thus 10 acres of established pastures under rotational grazing.

The period of grazing for each paddock was set down at five days with a spell period of 20 days. The animals did well but there was no way of determining just how much each pasture contributed to this gain. During 1947 a duplicate set of the pasture mixture treatments was established, making nine paddocks totalling 18 acres.

These paddocks were ready for grazing by the winter of that year and in order to cope with the increased pasturage the herd number was raised to 16. The grazing period of each paddock was maintained at five days, thus subjecting the pastures to more intensive treatment, but a much longer recovery period of 40 days also resulted from this arrangement. In July, 1948, the first mob of Herefords was sold for slaughter and replaced by 16 Shorthorn steers from Spring Creek Station.

Plate 167.

Stock Yards and Weighbridge at Bureau of Tropical Agriculture.

In August, 1948, a weighbridge was installed in order to obtain liveweight gains of the animals at regular intervals. It was found that, to fit in with other routine activities on the Bureau, weighing the animals on the same days each week would be necessary. This involved a recasting of the grazing schedule of the plots, whereby the two paddocks of like treatment were grazed in conjunction for a period of seven successive days with a spell period of 28 days. To provide for the latter it was necessary to bring in another two-acre paddock of molasses grass, which was thereafter grazed in conjunction with the palatability trial in rotation with the four pasture mixtures. Even with this reduced recovery period the stock were unable to cope with pasture growth during the seasons of heavy growth in February and March.

After two years of grazing with this high rate of stocking some of the pasture mixtures showed signs of overstocking. The mixture most affected in this way was molasses grass and puero. For the first year this mixture gave the best results, but by 1950 purple top Guinea grass and centro was the more impressive pasture. At present plots of the latter appear better than at any time since their establishment.

From these trials it would appear that stylo is unable to grow in association with Guinea grass. The grass by its vigorous nature completely outstrips the legume in growth and the latter, not being shade tolerant, is quickly choked out of the pasture. Centro, on the other hand, twines around the stools, can grow in partial shade, and is sufficiently vigorous to be able to compete with Guinea grass. It promises, therefore, to be a very useful component of Guinea grass pastures. Both puero and stylo will combine with molasses grass

In the trials at the Bureau, puero has done well with molasses grass, but molasses grass has not the carrying capacity of Guinea grass and has shown signs of weakening under the very heavy stocking rate being used. Calopo grows quite well with molasses grass but the legume is not very acceptable to stock and is consequently not grazed. Thus the paddock often has the appearance of a pure legume stand rather than a legume-grass mixture. Calopo has, however, an apparent use in the rejuvenating process of run-down pastures and for this reason cannot be entirely ruled out. There is evidence, too, of cattle eating this legume and doing quite well on it, but from Bureau experience this cannot be wholeheartedly supported.

GRAZING MANAGEMENT OF PLOTS.

The general technique of grazing has been to allow the cattle as much freedom of movement as possible. There is a central water trough and woodlot connected to each paddock by a laneway. The procedure is to open the paddock that is to be grazed, place the animals in this paddock after weighing, and thereafter allow them to seek water and shade at will, except on weighing days. Usually the bullocks leave the paddocks of their own accord about 8 o'clock every morning, drink at the trough and proceed to the woodlot. They do not return for grazing until 5 p.m. On the other hand, on dull showery days they have to be driven from the paddocks. Water and shade are not provided in the paddocks because much of the efficiency of the grazing plots would be lost in camping and trampling if this were done.

MANAGEMENT OF THE STOCK.

Ear tags have been found to be the quickest and most accurate method of identifying stock, but cheek branding is also used in case the tags are pulled out. When weighing commenced it was decided to dehorn the station stock, which were unaccustomed to frequent handling and were difficult to draft in small yards and weigh. However, the first dehorning caused considerable loss in condition, and the animals still remained difficult to handle for a considerable time. As a consequence the next mob was tipped rather than dehorned and this proved very successful. Little weight was lost, the stock worked freely in the yards and they have shown little inclination to horn each other.

Plate 168.

Shorthorn Steers Grazing on Guinea Grass and Stylo, Bureau of Tropical Agriculture.

The first step in the introduction of beef stock into grassland experiments is to see that all paddocks are securely fenced. It is important to ensure that reasonable facilities in the way of saddle horses exist for the handling of cattle, and that strongly constructed yards, sufficiently high to dispel any desire on the part of the animals to attempt an escape, are available on the property. Low yards or widely spaced rails in a yard are dangerous and do not assist in the quietening of beasts.

Station cattle are not accustomed to being yarded very frequently. They usually associate it with some drastic treatment such as branding or dipping, and their recollection of the severe nature of most of these experiences makes them nervous and somewhat difficult to handle. As a result of repeated handling from which no harm befalls the animals, they become very quiet and can, after six months, be worked on foot if the attendant takes them quietly. Before this stage is reached, however, all handling of the animals must be done on horseback.

NOTES ON THE PASTURE MIXTURES TESTED.

Purple Top Guinea Grass and Centro.

Paddocks of this pasture have been most impressive because of the even dark green colour and perfect cover. There is a preponderance of centro in the stand, but over the past year the legume does not appear to have increased appreciably. It is believed that centro would maintain a better balance if planted with the more vigorous common Guinea (*Panicum maximum* var. *typica*). *Glycine javanica* or stylo might prove more suitable with the less vigorous but more palatable purple top Guinea grass. Green panic or fine stem Guinea grass (*Panicum maximum* var. *trichoglume*) might also provide a good balance with either of these two legumes.

Plate 169.

Purple-top Guinea Grass and Centro Pasture, Bureau of Tropical Agriculture.

Molasses Grass and Calopo.

A dense cover has been maintained in one of these paddocks; the other, on poorer ground, is less satisfactory. At times the cover has varied from what appears to be a pure legume stand to a really good grass-legume mixture. It is considered that as calopo is not as readily acceptable to animals as the grass, it tends to dominate the stand. From observations at the Bureau to date it cannot yet be determined whether it is a useful species in a molasses grass pasture or whether it should be abandoned as an unsuitable species. Whatever may be the outcome of future observations, it certainly looks at present as if calopo could play an important role in rejuvenating deteriorated pastures because of its vigorous growth and weed choking potentiality.

Guinea Grass and Stylo.

Evidence is now fairly definite that in good Guinea grass stands stylo has not the capacity to maintain itself under tropical coastal conditions. Where the Guinea grass stand is scattered, in one paddock of this mixture, there is a fairly liberal amount of stylo uniformly distributed throughout the area. In the other paddock, where Guinea has made really good growth and the population of the grass is dense, stylo has almost completely disappeared.

Observations indicate that stylo may combine satisfactorily with the less vigorous varieties of *Panicum maximum* such as purple top Guinea grass and green panic. This legume has much to commend it. Features such as its adaptability, persistence, ability to spread and availability of seed all combine to render it a potentially important pasture legume.

Plate 170.
Guinea Grass and Stylo Pasture, Bureau of Tropical Agriculture.

As a result of rotational grazing, centro has been introduced into this paddock and has taken possession of a small area at one end. This is a really conspicuous section of the paddock, for not only does the grass look greener but it possesses a much softer and quicker flush. Moreover, the grazing animals tend to concentrate on this area as soon as they find their way into the paddock. From this and other observations it seems certain that common Guinea grass and centro would prove ideal in combination. This also furnishes evidence of the ability of centro to colonise—an important character in pasture species—and its superiority over stylo under conditions obtaining at the Bureau of Tropical Agriculture.

Plate 171.
Molasses Grass and Puero Pasture, Bureau of Tropical Agriculture.

Molasses Grass and Puero.

This combination has developed into a very good mixture in one of the paddocks at the Bureau. In the other, the effects of overstocking have been marked and the mixture is being overwhelmed by blady grass (*Imperata cylindrica*), para grass and blue top (*Ageratum conyzoides*). From observations to date, it would appear that under the present system of seven days grazing and 28 days spell, the stocking rate, which is equivalent to one beast per 1¼ acres, is too heavy for molasses grass even under a rotational system of grazing. In this mixture, however, there is evidence of an increase in the puero cover. Unlike calopo, puero is taken by cattle quite well, and there is no tendency on the part of the grazing animals to concentrate on the grass and neglect the legume.

Plate 172.
Molasses Grass and Calopo Pasture, Bureau of Tropical Agriculture.

CHEMICAL COMPOSITION OF THE GRASSES AND LEGUMES.

The variations found in the chemical composition of some of these grasses and legumes, as well as para grass, are shown in the following table.

RANGE IN CHEMICAL COMPOSITION OF EIGHT TROPICAL PASTURE SPECIES EXPRESSED AS PERCENTAGE OF WATER FREE MATERIAL.

Species.	Crude Protein.	Crude Fat.	Carbo-hydrate.	Crude Fibre.	Ash.	Ca O.	P_2O_5.
Para grass..	18·6–9·9	2·0–1·4	49·6–40·5	33·0–28·2	18·8–6·8	1·488–·341	·917–·388
Molasses grass ..	14·9–8·4	2·6–1·3	52·5–45·4	35·1–29·3	10·1–6·2	·513–·315	·940–·415
Guinea grass	16·2–6·8	1·7–1·0	46·9–41·7	36·4–32·0	15·6–7·4	1·00 –·413	·644–·276
Purple top guinea grass ..	15·7–3·0	1·7–0·7	49·4–37·2	45·0–26·3	16·1–10·9	1·63–·543	1·38–·593
Stylo ..	18·05–10·55	..	..	..	..	2·70–1·27	·75–·49
Centro ..	23·8–15·8	3·0*	38·4*	30·3*	9·6*	3·61–1·44	·84–·49
Puero ..	19·5*	1·2*	38·6*	34·3*	6·5*	2·63–1·047	·607–·42
Calopo ..	19·5*	1·2*	40·2*	31·1*	8·0*	2·117*	·584*

* Only one determination.

In the light of the detailed analyses carried out by him, Mr. W. J. Cartmill in a report in 1944 concluded that:—"Para grass pasture may be regarded as having an adequate protein content throughout the year. Similarly molasses grass, which has a crude protein content of 10% to 11% throughout the year, may be accepted as satisfactory as a supplier of protein. In both cases the protein levels are highest during the late wet season (February-March) and lowest during the pre-wet season (December-January). Moreover, the fibre content of these two grasses is not high, so that, provided the stock always have access to succulent leaf, the intake of the growth and energy producing constituents should be adequate. Guinea grass probably has an adequate crude protein content during the wet season, but the analyses indicate that in dry periods the fibre content of this grass is fairly high and the protein content correspondingly low, so that at these times the protein intake may not be sufficient for fattening purposes."

It will be seen that the protein values for the legumes are satisfactory and it could be expected that the use of these legumes with the tropical grasses would considerably improve the nutritive value of the pastures.

NOTES ON INTRODUCTIONS OF PASTURE SPECIES.

A small plant introduction area has been maintained at the Bureau of Tropical Agriculture ever since pasture work commenced there.

Of the more recent introductions, *Glycine javanica* is the most outstanding legume. Its apparent wide range of adaptability suggests that it might be useful for trial in areas further south. It may combine well with molasses grass, purple top Guinea grass and fine stem Guinea grass (commonly referred to as green panic in the Burnett and coastal areas south of Rockhampton). It has all the characteristics of a good pasture species, since it makes good growth, is palatable according to Southern Rhodesian experience, and seeds prolifically. Already it has shown more promise on the Atherton Tableland than any other legume yet established there. It is intended to establish a fine stem Guinea grass and *Glycine javanica* pasture mixture at the Bureau of Tropical Agriculture in the near future to examine further the usefulness of this legume.

Desmodium canum is a legume which has persisted in spite of severe competition. It is perhaps not vigorous enough for grasses such as common Guinea grass and molasses grass but may prove suitable with fine stem Guinea grass and other species which do not make rank tall growth.

Desmodium scorpiurus favours less fertile land than most of the other legumes, and may prove a useful species in the poorer areas of the wet belt, just as Townsville lucerne (*Stylosanthes sundaica*) does in the drier areas.

The most outstanding grass introduction is *Andropogon gayanus,* a native of tropical Africa. It has outyielded common Guinea grass in monthly cuttings and appears soft and palatable but, as yet, has not been tested under grazing conditions.

Another promising species is *Brachiaria decumbens,* which also needs to be studied under grazing conditions. It has the capacity to remain green under adverse weather conditions.

Plate 173.

Andropogon gayanus, a Grass Introduced from Tropical Africa, Growing at the Bureau of Tropical Agriculture.

Dichanthium caricosum has not lived up to the high reputation it has gained in the wet Navau Valley of Fiji, and its value for the tropical coastal areas is in doubt.

UTCHEE CREEK RESERVE.

In order to test the experimental pasture mixtures which were being developed at the Bureau of Tropical Agriculture, three blocks of land comprising 660 acres were selected some years ago at Utchee Creek and were gazetted as an experimental reserve. Utchee Creek is situated some 20 miles from the Bureau and most of the area consists of steeply sloping land covered with dense rain forest, which is not suitable for cultivation.

A trial to examine the establishment of grasses and legumes following a scrub burn was commenced on a plot of 10 acres in 1941. The grasses—para, Guinea and molasses—all germinated well and good establishments resulted. Puero, centro, and calopo, the three legumes tried, all gave indications of ready establishment in a scrub burn.

Nothing further was done at Utchee Creek during the war years, but stock from neighbouring farms eventually found their way to the area where pasture species had been established. The stocking rate for the next few years was very heavy, and by the end of 1943, at least half the area had the appearance of a dense legume stand. The legume was the relatively unpalatable calopo, which had spread very vigorously following the suppression of grasses by the grazing stock. Puero had almost entirely disappeared, and centro had confined itself to the scrub margin, where it had climbed to a height of 30 feet. Calopo had also climbed the trees on the fringe of the clearing and it was not uncommon to find both calopo and centro together on the same support.

Plate 174.

A New Burn in Fallen Scrub, Utchee Creek, South Johnstone.

Plate 175.

Para Grass with Molasses Grass in Background, Utchee Creek, South Johnstone.

Plate 176.

Burnt-over Molasses Grass Showing Initial Weed Invasion, Utchee Creek, South Johnstone.

Plate 177.

Regeneration of Molasses Grass Following a Burn. The stylo seen in foreground was oversown. Utchee Creek, South Johnstone.

Plate 178.

Puero Dominating Molasses Grass when Oversown Following a Burn. No grazing has been allowed. Utchee Creek, South Johnstone.

Plate 179.

Shorthorn Steers ($2\frac{1}{2}$ years old) after 12 Months Grazing at the Bureau of Tropical Agriculture.

The area was fenced in 1944 with the object of keeping stock off the pastures. Within six months of fencing a complete change took place. Guinea grass, which seemed to have disappeared, reappeared vigorously and competed strongly with calopo. This was by far the most important observation made from this preliminary trial apart from the information gained in the initial establishment. It indicated that calopo is a legume which might prove useful in rejuvenating the deteriorated Palmerston areas. The ease with which it can be established, its capacity to burn well, and its ultimate failure to compete with Guinea grass under controlled grazing, suggested its use for reclaiming these areas. Of the other grasses, para grass survived in the area originally planted, while molasses grass was largely replaced by Guinea grass.

In 1946 a second area of 10 acres was felled and seeded to molasses grass. A very quick grass cover resulted. The object of this trial was to determine whether tropical legumes could be introduced into an already established pasture. The paddock was fired in 1948. Stylo was broadcast over half the burnt area and puero over the other half. Both the legumes germinated well and good mixtures of molasses grass and stylo and molasses grass and puero have been obtained. Puero, however, has been outstanding and a first class mixture has resulted. In addition, this vigorous creeper is in process of smothering all sucker growth. The stylo section may improve when the area is stocked at a later period.

By 1948 the work at the Bureau had reached a sufficiently advanced stage to indicate definite lines along which future work might continue at Utchee Creek. An area of 40 acres was cleared at the latter centre with the object of establishing grazing trials. Clearing began in August, and by late December the area was fired and seeded. The area was divided into 10 paddocks each of four acres. All the combinations considered worthy of trial at Utchee Creek could not be tested in one experiment. Seed of puero was in very light supply at that time and the choice of legumes was therefore restricted to stylo and centro. The treatments were as follows:—Molasses grass and stylo, molasses grass and centro, para grass and stylo, para grass and centro, Guinea grass and stylo, Guinea grass and centro, molasses grass, Guinea grass, para grass, and Guinea grass with molasses grass. Each of these grasses and grass-legume mixtures germinated well, and excellent establishments were recorded by April 1949. It is hoped to complete the fencing of these small paddocks and the erection of the yards and weighbridge shortly.

It is intended that each of these four-acre paddocks will be grazed continuously by three bullocks. Every three weeks the animals will be removed for spraying and weighing, and then returned to their respective paddocks. The response of the pastures to this type of management will be closely studied.

CONCLUSION.

The results obtained at the Bureau of Tropical Agriculture and the experience of successful graziers on the tropical coast would indicate that approximately 30,000 head of 2-year-old stores could be fattened in this area annually, on the 50,000 acres estimated to be suitable and available for tropical pastures, if a suitable reliable pasture mixture can be developed.

This would mean that 30,000 head of young stores could be taken annually from the pastoral holdings of the Peninsula, north of a line from Cairns to Normanton. The removal of these 2-year-old beasts would considerably lessen the number of 3-and-4-year-old stores carried on these breeding properties, and this would favour a considerable increase in the number of breeders.

The importance of this exploratory work is therefore considerable, but much remains to be done in connection with the actual pasture mixtures and their relative values. The problems associated with the animal husbandry aspects of this work, such as the maximum production rate of beef, the type of breed best suited for coastal fattening, and the optimum age of beast at which such fattening should begin are matters which still require investigation.

DAIRY PASTURE INVESTIGATIONS.

The Agriculture Branch now has 83 pasture trials, with a total area of about 200 acres, established on dairy farms in Queensland.

This information is given by the Director of Agriculture (Mr. D. O. Atherton) in the Annual Report of the Department for 1950-51.

Sixteen large-scale farm grazing trials are in progress, but it will be some time before definite results can be reported from them.

Based on marked responses to fertilizers in preliminary trials at Gympie, Conondale, Peachester, Eungella Range and Chilverton, six new trials combining fertilizer treatment with sown pastures have been planned.

On the Blackall Range, marked increases in milk yields were recorded following renovation and topdressing of paspalum-white clover pastures. The individual treatments are now being studied separately to determine their contribution to the increased yields.

Minor element trials have been laid down in various districts, and a large trial is being conducted with other branches of the Department in an endeavour to find some means of remedying copper deficiency of pasture areas on the Near North Coast.

Approximately 64 acres of hillside pastures have been contour furrowed in the Gympie, Beaudesert and Brisbane Valley districts, with marked response. The method involves ploughing contour furrows at vertical intervals of two to three feet.

Motor mowers are being used in the Moreton and Atherton Tableland districts for investigating the value of regular mowing of blady grass on steep slopes as a means of encouraging better grasses. Results obtained at Pimpama and Peachester suggest that on arable land blady grass can be controlled by ploughing, cropping and resowing to pasture. Discing and resowing may also be effective in some areas.

Seven trials are directly concerned with mat grass control. They suggest that the practice of cultivating infested areas and resowing to pasture is most likely to be effective in preventing the reintrusion of mat grass if a tall-growing pasture species is used.

Twenty-one small pilot plots are maintained with the object of determining the suitability of various pasture species for each dairying district. An introduced fine-stemmed Guinea grass is among the most promising of the newer grasses and it is hoped to build up seed supplies of this grass in due course.

Strawberry Culture.

C. N. MORGAN, Senior Adviser in Horticulture.

THE strawberry is grown in Queensland from the New South Wales border to the far north, but the main producing districts lie within 150 miles north and 50 miles south of Brisbane. The mild winter in this area ensures a long picking period, which frequently extends from June to the end of December. Crops in the northern portion of the State have a much shorter cropping season.

Plate 180.

A Well Grown Strawberry Patch.

During the early part of the harvesting period, the fruit sells readily on the fresh fruit market in Queensland, and many growers also consign to the southern States, where the crop cannot be produced locally during the winter months. By using air transport, the fruit reaches the Sydney and Melbourne markets in first class condition. Late in the season, when market returns do not justify the expense of packing for the fresh fruit trade, the fruit is consigned to local canneries for jam making. The requirements of processors are increasing rapidly and large plantings are made especially to satisfy this demand.

Strawberry growing has some features which make it attractive to many farmers. Firstly, the crop is easily established and returns come in within three months; secondly, the outlay for planting material and equipment to work even a large area is not excessive; and thirdly, the crop fits into the normal farm programme satisfactorily. However, careful attention must be given to the selection of a suitable area for the crop and efficient cultivation in the field is essential for success.

VARIETIES.

The cultivated strawberry is a hybrid of two American species, *Fragaria virginiana* and *F. chiloensis*. The plant is a squat herbaceous perennial with dark green, serrated leaves and bears fleshy fruits with small seeds embedded in the surface. The fruits mature to a brilliant red colour. During the summer months, runners develop on the parent plant and root at the nodes. The runner material is used for propagation, each portion of a runner with an independent root system being capable of forming a new plant.

Two locally selected varieties, Phenomenal and Aurie (Plates 181 and 182) have proved satisfactory for Queensland conditions. They have plenty of vigour and produce medium sized, highly coloured, firm textured fruit which carries well and is suitable for the fresh fruit market and the processing trade. Both varieties bear self-fertile flowers

Plate 181.

Strawberry Varieties.

Left—Phenomenal with a rounded bush and pointed berries which are well protected by the leaves.

Right—Aurie with a flattish bush and wedge shaped berries which are somewhat exposed.

and produce good crops without having to be interplanted with a second variety for pollination. Phenomenal is grown more extensively than Aurie. The latter fruits a little earlier and may stand up to dry conditions better than Phenomenal, but the plants suffer rather severely at times from leaf diseases and the quality of the fruit is not so good.

Plate 182.

Fruit of the Variety Phenomenal—Typical Mid-season Berries. Early in the season, the fruit is much larger and usually irregular in shape.

None of the many varieties introduced to and tested in Queensland compares favourably with the local types in either yield or fruit quality.

Virus diseases such as yellow edge and crinkle are a constant threat to the industry and production therefore depends largely on the use of disease-free runners from vigorous, true-to-type plants. An approved runner scheme, whereby strawberry areas are inspected during the growing season, was inaugurated some years ago. If these areas comply with certain standards for plant type and freedom from disease, they are listed as approved sources of planting material. Growers requiring plants should, where possible, obtain them from such approved sources.

LOCATION AND SOILS.

The strawberry crop should be grown in a district with ready access to markets, suitable climatic conditions for the plant and usually a reliable supply of water for irrigation. Irrigation is particularly important in crops grown on some light-textured soils which dry out quickly during the winter and spring months.

Under favourable conditions strawberries do well on almost any type of soil, but well-drained, sandy loams with a good water-holding capacity are generally preferred for the crop. Irrigated areas on red-brown basaltic loams yield particularly well. Where the drainage is good, heavy loams may be planted, especially if water for irrigation is limited or unavailable. On badly drained soils, weed growth is difficult to control, root rots are apt to thin out the stand, and the strawberry plants usually lack vigour.

In the main producing areas, land which is too cold for the more frost-susceptible crops during winter can often be planted profitably to strawberries. New land has many advantages for the crop, not the least of these being the small amount of weed growth during the first year of cultivation. Old land will grow good fruit provided it is well prepared for the crop, adequately supplied with organic matter and fertilized correctly.

LAND PREPARATION.

As the crop is planted in autumn, land preparation should begin in spring in order to get the soil into a good tilth. Though the strawberry is not a deep-rooted plant, ploughing to a depth of eight inches is usually required to improve the water-holding capacity of the average soil. After the initial ploughing, new land should be fallowed for two to three months before the second ploughing is carried out. On old land, a cover crop of Poona pea or maize can be sown during the spring and ploughed under in late summer before planting the strawberry crop; a further ploughing and the subsequent cultivation should bring the ground into good condition for planting. Thorough cultivation before planting does much to firm and level the ground as well as to control weed growth.

Strawberries frequently do well after a late spring vegetable crop which has been well fertilized and regularly cultivated during the growing period. The preparation of such land is comparatively easy.

On shallow or badly drained soils, it may be necessary to plant on raised beds.

FERTILIZING.

Fertilizing practices depend largely on the cropping history of the land. On a soil which is rich in organic matter and has previously grown a heavily fertilized crop, only a light basal dressing is necessary. Where practicable, however, a heavy dressing of farmyard manure should be applied to the soil a few weeks prior to planting. Farmyard manures should be supplemented by a preplanting dressing of a complete fertilizer mixture approximating 5:13:5.

When farmyard manure is not available, commercial fertilizers may be used as a preplanting dressing on well-prepared ground containing a reasonable amount of organic matter. A heavy basal dressing is necessary and amounts of from 15 cwt. to 1 ton per acre are not excessive. A 5:13:5 mixture containing a fair proportion of blood and bone is suitable for most soils. Strawberries may also respond well to basal fertilizer dressings rich in potash. On the red-brown loams which rapidly "fix" a large part of the phosphoric acid and thus make it unavailable to the plants, the fertilizer should be spread in a narrow band about one foot wide along the row which is to be planted and cultivated into the soil about 10 days prior to planting.

Topdressings of fertilizer are usually needed during the growing period. The first topdressing is applied when flowering begins and this is followed by further dressings, the number of which depends on the appearance of the plants and the size of the fruit. About 1-1½ cwt. per acre of a water soluble fertilizer such as a 5:14:5 mixture is needed at each top dressing. Topdressings rich in potash frequently improve the quality of the berries, particularly in soils in which this element is low in supply; a 4:13.5:12 mixture is suitable for this purpose. Straight nitrogen fertilizers such as sulphate of ammonia should be used with caution as they may cause excessive leaf growth, delay in the maturing of early fruit, and lack of firmness in the fruit. Topdressings are applied at the sides of the plant row in such a way that no fertilizer comes in contact with the fruit or leaves. In order to avoid any risk of burning, the plants should be irrigated after each topdressing whenever practicable.

ESTABLISHING THE CROP.

Strawberries are grown in Queensland as an annual crop and it is only on rare occasions that the parent plant remains in the ground for a second year. This practice is largely brought about by the difficulty of controlling weeds during the wet summer months but quite apart from this, the fruit from a ratoon crop does not compare either in size or quality with that from a plant crop. Annual planting is, therefore, sound practice.

Planting Material.

Planting material is usually obtained from a selected area reserved from the previous crop for runner production. Provided they are well looked after, about 1,500 plants yield enough runners to plant one acre. It is particularly important that the plants should be vigorous, true to type and free from disease, for runners from undesirable mother plants produce a most unsatisfactory crop. Severe rogueing should therefore be carried out in the runner bed. Diseased and backward plants must be destroyed as soon as they are detected in the field. Off-type plants which are bearing fruit can be clearly marked and then chipped out as soon as picking is finished.

To encourage the production of sturdy, well-rooted planting material (Plate 183), the runner bed must be regularly cultivated and, if necessary, watered. A light topdressing of fertilizer when the runners first appear in December is required. Weeds grow rapidly at this time of the year and they should be controlled before the runners spread out between the rows. Runners growing in competition with weeds and shaded by them are weak and frequently wilt when they are transplanted. Furthermore, runners from a weed infested bed may carry weed seeds to the new area and offset the work carried out in preparing the ground.

Prior to removing the runners, the beds should be well watered to facilitate digging. In order to avoid injuring the plants, it is best to commence digging the runners at some given point and work through the area on a face. The runners are lifted carefully and separated from each other with a small trowel or a strong-bladed knife, the roots being trimmed to about three inches and all broken and dead leaves removed (Plates 184 and 185). A few of the older leaves also may be removed to lessen transpiration after planting, but excessive leaf pruning is undesirable as the plants may take a long time to become established. After trimming, the runners should be placed either in a bucket containing a little water or between wet bags, and protected from both wind and sun. As far as practicable, no more runners should be dug than can be replanted on the same day.

Plate 183.

Strawberry Plant with New Runners. Runners first appear in December and each plant may provide 10 to 15 suitable runners.

Plate 184.

A Strong Healthy Runner Suitable for Planting, before Trimming.

Plate 185.

Runner Trimmed for Planting. The roots are shortened where necessary and broken and damaged leaves removed.

Only healthy runners with a good root system and a well-developed crown should be planted. The older plants—that is, the first and second on each runner—are often preferred as planting material but it is a difficult and tedious job to sort them out. In any case, the crop grown from such plants seldom bears earlier than a crop grown from sturdy plants roughly graded for size prior to planting.

Planting.

The strawberry crop is planted in March, but in a mild autumn planting may continue until early April without affecting the bearing period to any great extent. Planting in February for a very early

harvest is hazardous as the crop is difficult to establish in hot weather, particularly where irrigation is lacking or water is improperly used. Furthermore, crops which are planted very early tend to make excessive leaf growth.

Care in transplanting is essential and the runners must be set with the crown just above ground level (Plate 186). If they are set too low, the crowns silt up and the plants die or make unsatisfactory growth; if set too high, the roots may dry out. It is difficult to transplant runners at the correct depth unless the land has been well prepared for the crop and allowed to settle before the surface is levelled by raking or some other means. When planting, a wire is stretched along the row and the plants are set alongside it; the straight rows obtained in this way are easy to cultivate by tractor, horse and hand implements.

Plate 186.

Depth of Planting. Left—correct; centre—too shallow; right—too deep.

Each planting hole is made by hand or trowel and should be large enough to take the plants, which are set at the correct depth with the roots well spread out. The soil is then firmed around the roots, care being taken to prevent dirt getting into the crowns. As soon as possible after transplanting, the crop should be irrigated or watered in by hand. Planting out is best done in the afternoon.

Strawberry runners may be planted in single or double rows. Single row planting is practised on most farms owing to the ease of cultivating the crop and harvesting the fruit (Plate 187). The number of plants per acre in a single row crop is less than in a double row crop, but this

is not an important consideration on most commercial areas. Double row plantings take approximately 40 per cent. more runners than the same area planted in single rows, but tractor and horse implements cannot be used and all cultivation must be done by hand hoe.

Plate 187.

Planting Strawberries. Note young plants covered with wet bagging and set out along straight planting line.

Planting distances vary according to the implements in use but common spacings for single row plantings are 2½ feet between rows and 15 inches between plants in the row. For double row plantings the best spacings appear to be 3½ feet between the centres of adjacent pairs of rows with 15 inches between the two rows in each pair and 15 inches between plants in the row. The numbers of plants required per acre are shown in Table 1.

TABLE 1.

Strawberry Plants per Acre.

Single Row Planting.

Distance between Rows.	Distance between Plants.	Number of Plants.
	Inches.	
2 ft. 6 in.	12	17,424
	15	13,939

Double Row Planting.

From Centres of Double Rows.	Distance between Rows.	Distance between Plants.	Approximate Number of Plants.
	Inches.	Inches.	
3 ft. 6 in. ..	15	12	25,000
		15	20,000

MANAGEMENT IN THE FIELD.

Cultivation between and in the rows is necessary to control weed growth. As the strawberry is not a deeply rooted plant, only shallow implements can be used. A dutch or flat hoe is suitable for close work between the plants and small hand cultivators fitted with hoe attachments are generally used in the rows (Plates 188 and 189). Tractor and horse cultivators should be fitted with duck-foot tynes to ensure shallow working. When chipping by hoe, care must be taken not to pull soil away from the plants, and conversely not to lift soil into the crowns.

Plate 188.

Small Hand Cultivator, Fitted with Sweep Type Hoe Attachment.

Plate 189.

Hand Cultivator in Use.

Irrigation.

Irrigation is highly desirable for the strawberry crop as the plants quickly react to dry weather, particularly during the cropping period. Lack of soil moisture is soon followed by a reduction in both fruit size and quality.

On the red-brown loams and some other open types of soil, it is difficult to grow strawberries without irrigation. Water is usually applied by an overhead system such as the Skinner system, which appears to be the most suitable for the crop. Occasional heavy waterings should keep the plants growing satisfactorily until harvesting begins. From then on, about 30 to 50 points is applied at intervals of three or four days. The amount required varies with the soil type but sufficient should be used to keep the plants in full production. Some splashing of the fruit is unavoidable, but the fruit can be washed in the picking trays when it is harvested and allowed to drain in the packing shed.

Mulching.

Mulching is useful in controlling weed growth, conserving moisture in the soil and keeping the fruit free from dirt, including that which is splashed up from the surface of the ground by rain or irrigation water. On the other hand, a mulch may aggravate damage to the fruit from certain ground-frequenting insect pests. Materials used for mulching are oak-leaves, blady grass and tan bark. All of these, if spread around the plants to a depth of an inch for about six to eight inches on each side of the row, soon settle down to a good firm mulch. The mulch does not interfere with topdressings, as the soluble fertilizer used for this purpose quickly passes into the soil.

Sawdust is unsuitable as a mulching material for strawberries as it sticks to the ripe fruit and is difficult to remove when the crop is harvested.

HARVESTING.

Strawberries should be picked for the fresh fruit market when they are about three-quarters coloured. Factory fruit may be allowed to develop full colour, as at this stage the stems are easily removed. To handle the crop successfuly, daily picking during the main part of the season is often necessary and rarely is it possible to allow picking to extend further than every second day.

The fruit is picked into trays and sorted into first class and factory grades in the field during harvesting. Sizing is carried out in the shed, where the strawberries are packed into 8 in. x 4 in. x 1¼ in. boxes in single layers of threes, fours or fives for the fresh fruit market. Special containers holding approximately 14 lb. are used for factory consignments.

INTERSTATE TRADE IN FRUIT AND VEGETABLES.

Statistics of interstate movements of horticultural products during 1950-51 show that exports from Queensland included 426,991 cases of pineapples, 103,435 cases of bananas, 31,305 cases of mangoes, 262,397 bags of pumpkins, 114,645 cases of beans, 66,500 cases of cucumbers, 479,697 cases of tomatoes, and many thousands of packages of other produce.

TUBERCULOSIS-FREE CATTLE HERDS.
(AS AT 19th NOVEMBER, 1951.)

Breed.	Owner's Name and Address of Stud.
Aberdeen Angus ..	The Scottish Australian Company Ltd., Texas Station, Texas
	F. H. Hutton, "Bingegang," Dingo
A.I.S.	F. B. Sullivan, "Fermanagh," Pittsworth
	D. Sullivan, "Bantry" Stud, Rossvale, *via* Pittsworth
	W. Henschell, "Yarranvale," Yarranlea
	Con. O'Sullivan, "Navillus Stud," Greenmount
	H. V. Littleton, "Wongalea Stud," Hillview, Crow's Nest
	J. Phillips and Sons, "Sunny View," Kingaroy
	Sullivan Bros., "Valera" Stud, Pittsworth
	Reushle Bros., "Reubydale" Stud, Ravensbourne
	H. F. Marquardt, "Chelmer," Wondai
	W. G. Marquardt, "Springlands," Wondai
	A. C. and C. R. Marquardt, "Cedar Valley," Wondai
	A. H. Sokoll, "Chelmsford," Wondai
Ayrshire	L. Holmes, "Benbecula," Yarranlea
	J. N. Scott, "Auchen Eden," Camp Mountain
	"St. Christopher's and Iona" Studs, Brookfield Road, Brisbane
Friesian	C. H. Naumann, "Yarrabine Stud," Yarraman
	J. F. Dudley, "Pasadena," Maleny
Guernsey	C. D. Holmes, "Springview," Yarraman
Jersey	W. E. O. Meier, "Kingsford Stud," Rosevale, *via* Rosewood
	J. S. McCarthy, "Glen Erin Jersey Stud," Greenmount
	J. F. Lau, "Rosallen Jersey Stud," Goombungee
	G. Harley, Hopewell, Childers
	Toowoomba Mental Hospital, Willowburn
	Farm Home for Boys, Westbrook
	F. J. Cox and Sons, "Rosel" Stud, Crawford, Kingaroy Line
	R. J. Browne, Hill 60, Yangan
	P. J. L. Bygrave, "The Craigan Farm," Aspley
	A. Verrall and Sons, "Coleburn Stud," Walloon
	R. J. Crawford, "Inverlaw Jersey Stud," Inverlaw, Kingaroy
	P. H. F. Gregory, "Carlton," Rosevale, via Rosewood
	E. A. Matthews, "Yarradale," Yarraman
	A. L. Semgreen, "Tecoma," Coolabunia
	G. & V. Beattie, "Beauvern," Antigua, Maryborough
	L. E. Meier, "Ardath" Stud, Boonah
	A. M. and L. J. Noone, "Winbirra" Stud, Mt. Esk Pocket, Esk

RADIO TALKS TO FARMERS
(Australian Broadcasting Commission)
4QR AND REGIONAL STATIONS
THE COUNTRY HOUR—Daily from 12 noon to 1 p.m.
4QG AND REGIONAL STATIONS
COUNTRY NEWS MAGAZINE—Every Sunday at 9 a.m.

PLANT PROTECTION

Phoma Rot of Tomatoes.

J. C. JOHNSON, Assistant Pathologist, Science Branch.

THIS disease was first recorded in Queensland in 1926, and though usually regarded as being of minor importance, it may become a serious problem to tomato growers during seasons of high rainfall. Under such conditions it may prove to be the most serious cause of fruit wastage, both in the field and during transit to the market. The causal agent is the fungus *Phoma destructiva* Plowr., which is a wound parasite gaining entry through injuries present on the surface of the fruit.

Symptoms.

On the fruit, infection occurs frequently at the stem end, where it causes sunken lesions not unlike those caused by target spot (Plate 190). In this case the fungus enters through the stem scar. Fruit showing ring or star cracking is particularly susceptible, while roughly handled or hail damaged fruit may become infected on all surfaces (Plates 191 and 192). It is this last type of infection which causes the greatest amount of transit loss, since the others are more often encountered at the time of harvesting, when they are rejected.

Plate 190.
Phoma Rot of Tomato. Stem end infection.

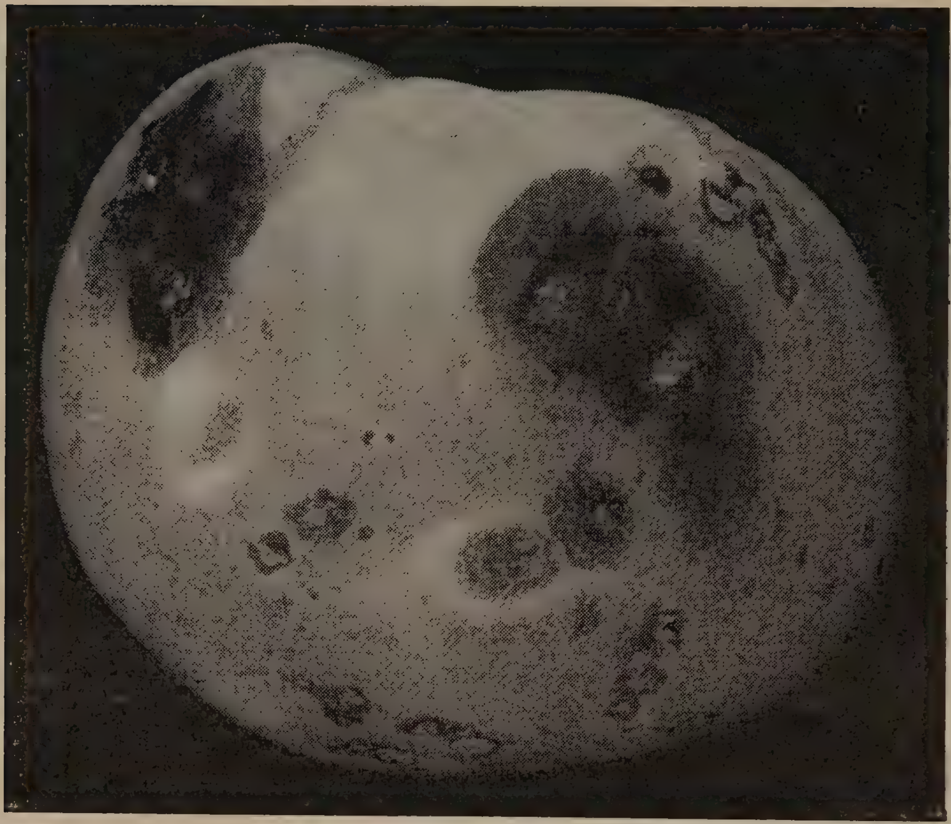


Plate 191.

Phoma Rot of Tomato. Transit rot produced by careless harvesting or packing. Note damaged skin of fruit.

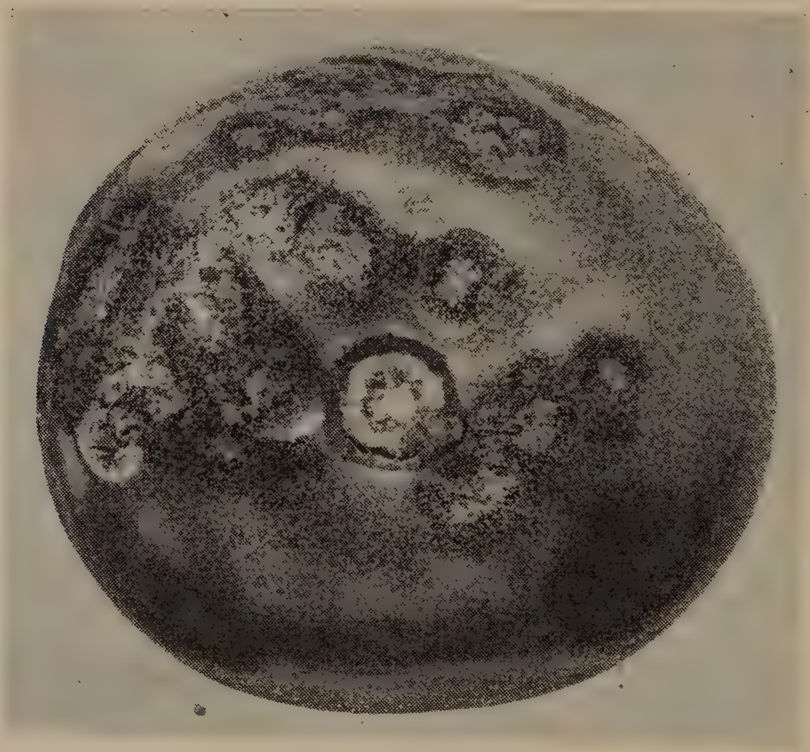


Plate 192.

Phoma Rot of Tomato. Infection following hail damage.

The small circular spots as they first appear on the ripening fruit are usually somewhat depressed and show little discolouration of the underlying tissue. A close examination of the larger lesions, especially when held towards the light, will reveal the presence of numerous minute erupting spore-producing bodies in the centre of the diseased area. The pimpled appearance which this gives to the lesions is a

distinguishing feature and one from which the older name of pimply rot was derived. The infected tissue usually later becomes dark and sunken, but this is not always the case, for under certain conditions large infected areas may occur and be neither sunken nor dark. The pimply appearance is, however, a constant feature of the disease. The invaded tissues remain quite firm unless invaded by other soft rot organisms.

The fungus is able to grow and produce an abundance of spores on dead tomato leaves which often accumulate under older plants. In periods of exceptionally high rainfall, the leaves, leaf stalks and stems of the growing plants may also be attacked, and large dark lesions showing concentric ring markings are produced. These symptoms are again very similar to those produced by target spot.

Control Measures.

The amount of fruit wastage in the crop depends largely upon what precautions are taken right through the growing period. Residues from previous crops should be destroyed by raking and burning, or by some other means. Seed-beds should not be located near packing sheds or where diseased and discarded fruit from previous crops have been allowed to accumulate. The regular application of copper dusts or sprays, both in the seed-bed and in the field, will also serve as a form of protection. Where dead leaves accumulate under the plants, the fungus is able to build up a reservoir of infection from which the spores are conveyed to the fruit, and these should therefore be removed where possible. This practice should not prove difficult in staked or trellised crops.

Since infection takes place through skin wounds on the fruit, care should be taken to ensure minimum injury during harvesting and packing operations. This should include regular inspection of picking tins, packing benches and graders for likely causes of fruit injury, and the use of protective felt or soft sacking surfaces wherever possible. After harvesting, fruit should be kept in a dry place until it can be marketed.

Dairy Building and Equipment Competition, 1951.

R. A. PAUL, Director of Field Services, Division of Dairying.

THE above competition was designed and conducted by officers of the Dairying Division and financed from the Commonwealth Dairy Industry Efficiency Grant.

A total of 400 points was allotted for the competition, divided into two main sections and various sub-sections as follows:—

	Points.
Section 1.	
1. Dairy Buildings	100
2. Site of Premises	30
3. Water supply at Premises	30
4. Yards	30
5. General overall design	10
	200
Section 2.	
1. Cow preparation and milking facilities	80
2. Straining, Separating and Cooling	60
3. Cleansing, Sterilizing and Storage	60
	200
Total	400

The dairying districts of the State were divided into eight zones and prize money amounted to £50 in each zone, with a proviso for any or all of the prize money to be withheld if the judges considered the entries to be of insufficient merit to warrant award.

Prizes were—

First	£30
Second	£12
Third	£8

A total of 76 entries was received and competition was keen in all zones with the exception of the Warwick zone, where one entry was received and a second prize only was awarded.

It is the intention in this article and another in a subsequent issue, by illustrations and descriptive matter of some of the winning entries, to bring to the notice of dairymen the most up to date developments in dairy building and equipment design and operation, as a means of encouraging more efficient milking management.

ZONE 1 PRIZE WINNERS.

Zone 1 (judge, Senior Dairy Adviser C. L. Moran) included the districts of Dairying Division officers stationed at Ipswich, Esk, Beaudesert, Laidley and Boonah. Six entries were received and the prize winners were:—

1st—A. McDougall, Veresdale, with a total of 364 points out of a possible 400 points.

2nd—T. & E. Vayro, Helidon, with a total of 338 points out of a possible 395 points.

3rd—Mrs. Hilda A. Raabe, Gatton, with a total of 325 points out of a possible 395 points.

The building owned by Mr. McDougall is situated on the crest of a hill with three-way drainage, and faces north to gain the advantage of the prevailing cool breezes in summer and the maximum amount of sunlight in winter. The exterior of the shed is weatherboard, painted white, constructed on an 18-inch high concrete wall. Bails are lined with tongued and grooved hardwood enamelled pale blue, which makes for easy cleaning and gives a very cool appearance. The shed is ceiled to eliminate dust and the cobweb nuisance.

From the ground plan (Plate 193) and Plate 194 the general layout of the premises can be seen. The area directly in front of the shed is laid out in bananas, papaws, &c., while the back and eastern side is in lawn, the whole giving a large stock-free area away from the milk storage section.

The bails are of tubular steel and a four-unit milking machine is installed. The engine room also houses the sterilizer. The separator and wash-up rooms are lined with masonite enamelled white, and provided with louvred windows for ventilation and light.

The milk is cooled over a surface cooler and stored in a refrigerator. Plate 195 shows this equipment and also the hoist used to place the cans in and out of the refrigerator and on to the trolley for conveyance to the milk lorry shown in Plate 196. The slope of the land is such that the milk cans slide from the trolley to the table of the truck, thus obviating any lifting.

Ample rain water is available from four 1,000 gallon tanks, while dam water is also laid on for washing of floors, &c., and to provide stock water at the yards. As the plan shows, the spraying crush, isolation yard and feeding stalls are conveniently placed. Drainage from the shed and yards is excellent and taken well away from the shed area.

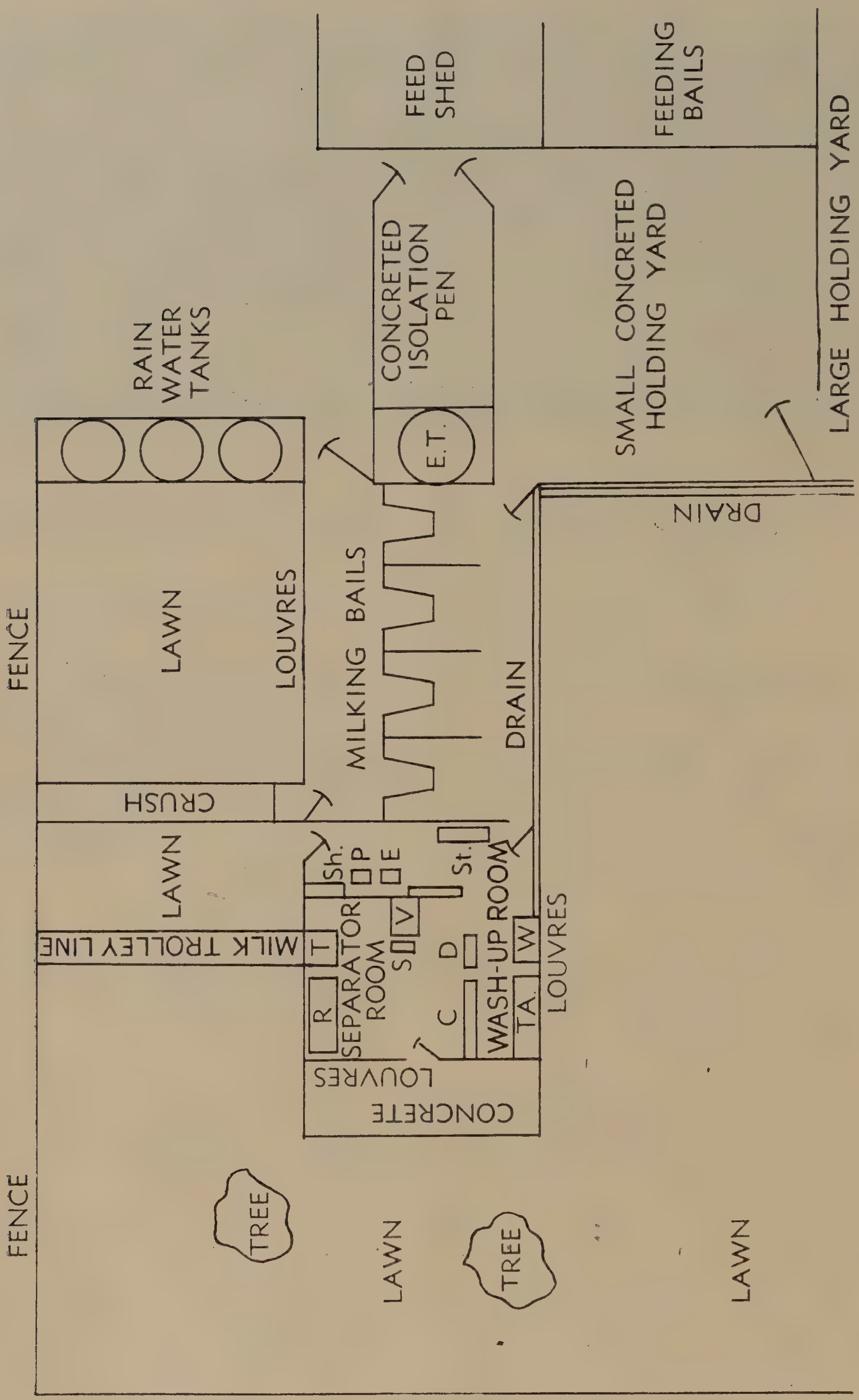


Plate 193.

Ground Plan of Premises and Surroundings—Mr. A. McDougall, Veresdale. C, can rack; D, draining rack; E, engine; E.T. elevated tank; P, pump; R, refrigerator; S, separator; Sh., shelf; St., sterilizer; T, trolley; TA, table; V, milk vat; W, wash-up trough.

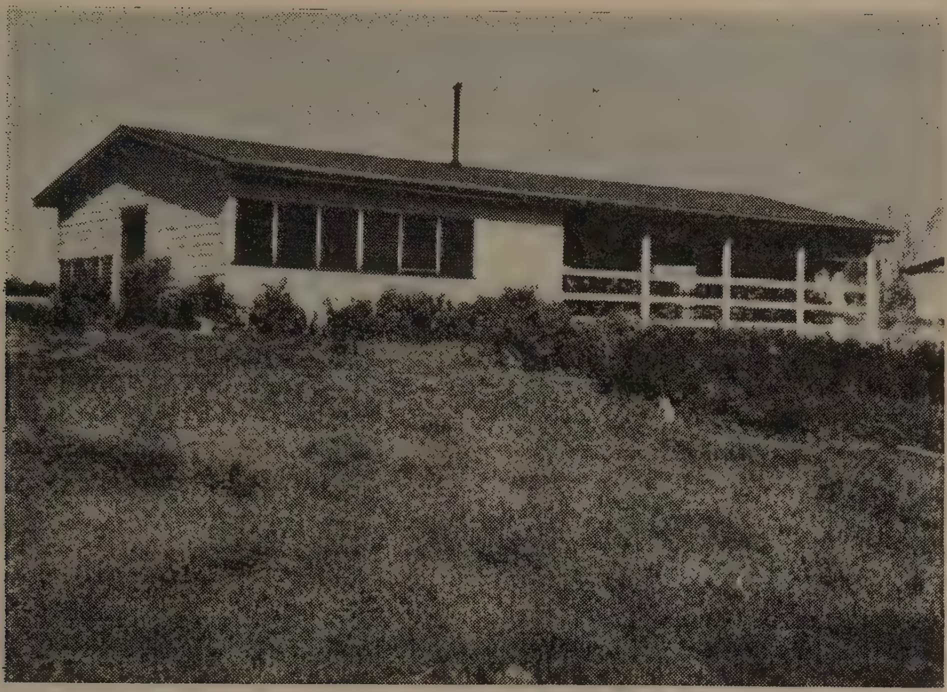


Plate 194.

View of Building—Mr. A. McDougall, Veresdale.

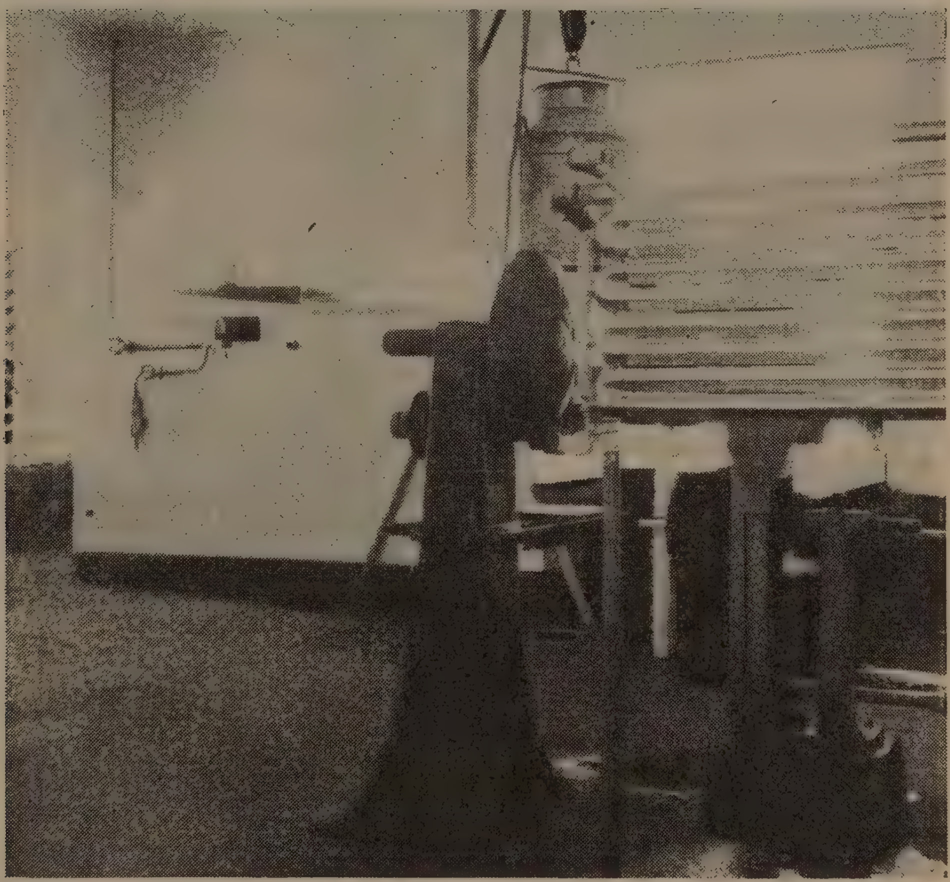


Plate 195.

Cooling and Refrigeration Equipment—Mr. A. McDougall, Veresdale.

The building of the second prize winners, T. and E. Vayro, has been erected a little over 12 months. It is the combined dairy building type with walk-through bails and is substantially constructed. It is painted and houses a four-unit milking machine, engine, sterilizer, wash-up troughs, racks and benches.

Plate 196.

Milk Being Loaded at the Farm of Mr. A. McDougall, Veresdale.

Plate 197.

Premises of T. and E. Vayro, Helidon.

The bails and yards are very well drained and water supply is adequate, but no provision has been made for a stock-free area or for shade and water for stock at the yards.

Plate 197 gives a general view of the buildings.

ZONE 2 WINNERS.

Twenty-five entries were received in Zone 2, which embraced the districts of Dairying Division officers stationed at Brisbane, Caboolture and Southport, and these were judged by Senior Dairy Adviser V. J. Brimblecombe. Due to the keen competition and merit of the top entries, the judge made the recommendation that extra prizes be awarded. This was agreed to and the following prizes were awarded:—

—	Judging Points.	Points Scored.	Per-centage.
1st—Mrs. J. Robinson, Southport	380	335	88·16
Equal 2nd—C. W. Pope, Samford	395	347	88
Equal 2nd—A. W. Houghton, Samford	395	347	88
Equal 3rd—Webb Bros., Woodford	400	344	86
Equal 3rd—Misses H. and D. Storey, Logan Village ..	395	339	86

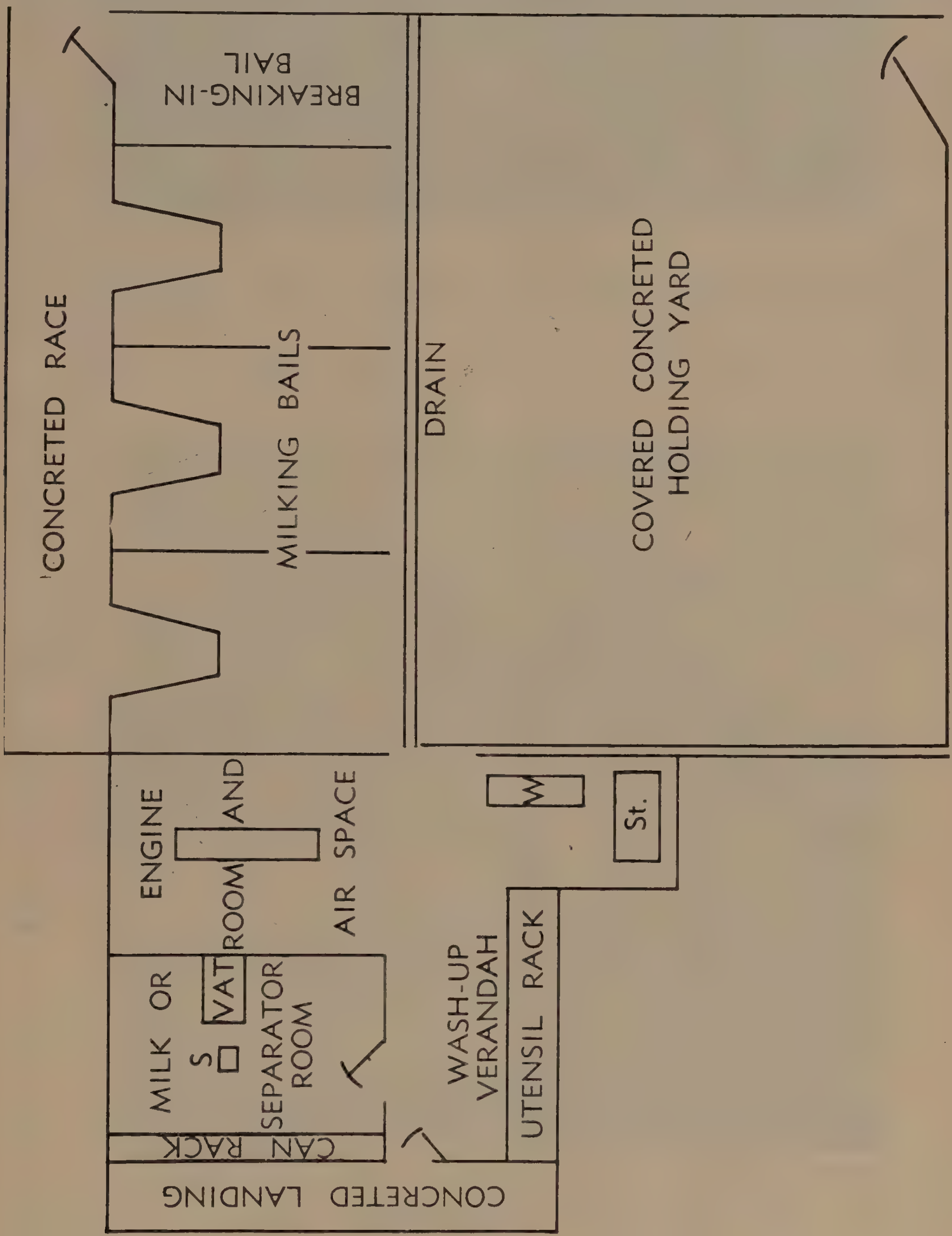


Plate 198.

Ground Plan of Premises—Mrs. Juila Robinson, Southport.

S, separator; St., sterilizer; W. wash-up trough.

Plate 199.

General View of Buildings and Yards—Mrs. Julia Robinson, Southport.

Plate 200.

Rear View of Shed—Mrs. Julia Robinson, Southport.

The general layout of the buildings and yards of the first prize winner is shown by the ground plan in Plate 198.

The bails are of the walk-through type with side gates leading to a fenced concrete race which takes the cows away from the treatment and storage end of the buildings. A feature of this shed is a special breaking-in bail for heifers, which can also be used for hand milking if desired.

The whole structure is on concrete curbings, and is well ventilated and painted white inside and out. An extension of the wash-up room houses the sterilizer and an outside concrete strip runs the full length of the end of the milk room.

In Plate 199 can be seen the high gable roof covering the concreted holding yard, while Plate 200 gives a view of the rear of the shed with the exit gates and race.

The building and yards are located on a well drained slope with a north-easterly aspect. An adequate stock-free area is provided, water supply for cleansing and stock purposes is drawn from the town main, good open concrete drains are provided and a belt of natural trees at the site provides shade and shelter.

The buildings of the equal second prize winners are very similar in design and the ground plan in Plate 201 gives the layout on the property of Mr. C. W. Pope.

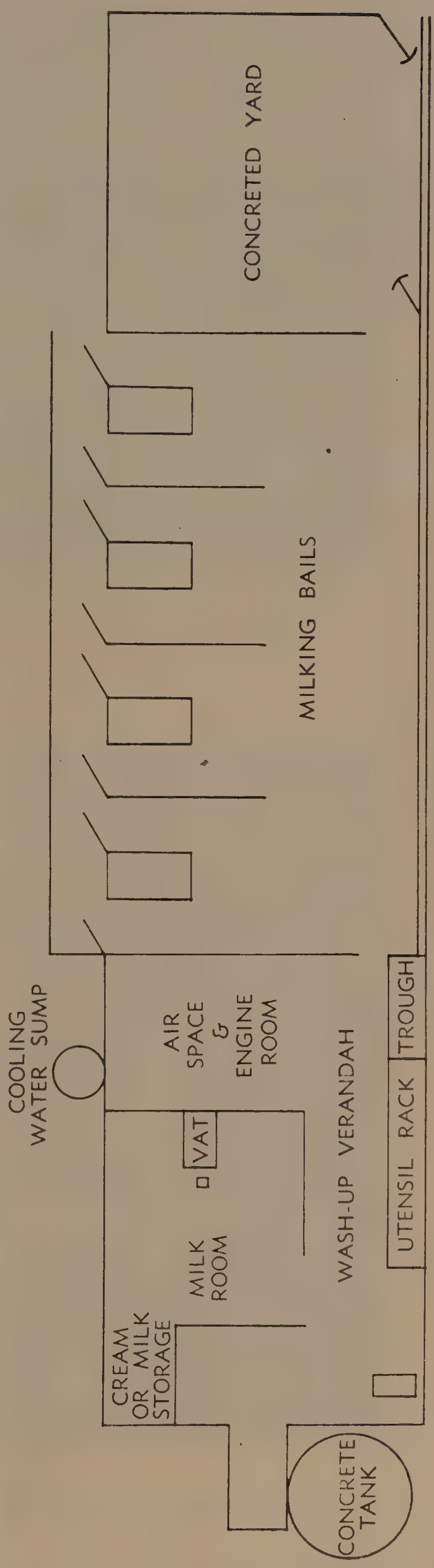


Plate 201.
Ground Plan of Shed—Mr. C. W. Pope, Samford.

The walls of this building are on concrete curbings, but the internal posts are in the cement. The dummy bails are suspended, thus making for ease in cleaning.

Plate 202.

General View of Building—Mr. C. W. Pope, Samford.

Plate 203.

General View of Building—Messrs. Webb Bros., Woodford.

The separator room is lined and the whole building painted white inside and out, giving a very attractive appearance. Provision of a stock-free area would be an improvement.

Plate 204.

View of Building—Messrs. Webb Bros., Woodford.

Plate 202 gives a general view of the building from the front looking into the bails. The buildings and yards are well positioned on sloping ground with an E.N.E. aspect. Drainage is excellent and ample water is available, from rain water tanks and an elevated tank supplied from a creek, for cleaning and stock purposes.

Plates 203 and 204 give general views of the buildings of Messrs. Webb Bros., showing a well constructed, attractively painted, gable-roofed crush type shed. The low white picket fence keeps the stock well away from the treatment end of the building, which features bottom ventilation on two sides and glass louvres shaded over to prevent the sun's rays from entering the room.

[TO BE CONTINUED.]

CHANGE OF ADDRESS.

Journal subscribers notifying change of address should state their full Christian names and surname as well as their full former and new addresses.

Address all communications to the Under Secretary, Department of Agriculture and Stock, Brisbane.

ANIMAL HEALTH

Parasitic Worm Diseases of Cattle.

P. J. O'SULLIVAN (Parasitologist, Animal Health Station, Yeerongpilly.)

(*Continued from page* 304 *of the November issue.*)

NEMATODES OR ROUND WORMS.

These are elongate rounded worms and include some of the most serious parasites infesting livestock. They vary tremendously in size. In our cattle the largest species measure up to four inches in length and the smallest is less than a quarter of an inch long.

The sexes are usually separate—that is, there are male and female worms, the male being smaller. Some kinds of roundworms require an intermediate host to complete their life cycle, as with the tapeworms and flukes, but the majority reproduce in the manner explained below.

The female worm lays her eggs, which are passed out in the manure. Under suitable conditions of temperature and moisture, the egg hatches to give rise to a tiny larval worm. This larval worm leads a free living existence, feeding on organic matter, bacteria, etc., in the dung and pasture. As development proceeds the larva moults twice, but during the second moult it retains its old larval skin as a protective sheath. This sheath gives the larva added protection against the effects of low temperature and dryness. The larva is now capable of infecting cattle. This "infective larva," as it is called, crawls up the grasses when they are wet with dew or rain and is thus available to the grazing animal.

Large Stomach Worm or Barber's Pole Worm (Haemonchus contortus).

This species (Plate 205) is found in the fourth stomach and is easily seen swimming free in the semi-fluid contents or adhering to the stomach wall when the contents are poured off. The female worm measures up to 1¼ inches in length and is red and white spirally striped; hence the name barber's pole worm. The spiralling is due to the white ovaries being wound round the straight red intestine. The male is smaller than the female and is uniformly pink in colour.

Life History.—The pre-parasitic phase of the life cycle of this worm follows the general pattern outlined above. When the infective larvae enter the host they cast their protective sheaths and burrow into the lining of the stomach and lie under a small blood clot. After a period of development they moult again and then leave the lining and enter the lumen of the gut and develop into adults by sucking blood from the walls. Eighteen to 20 days after ingestion the worms are mature and start laying eggs.

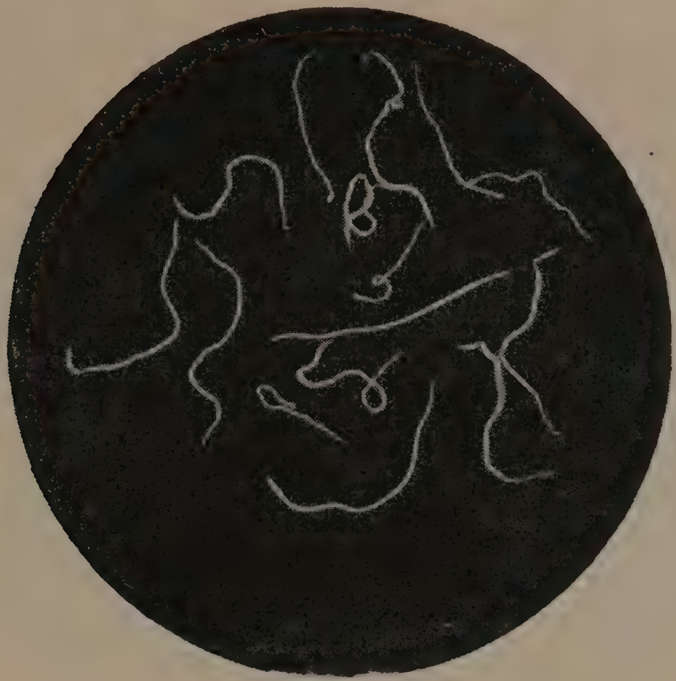


Plate 205.

Large Stomach Worm or Barber's Pole Worm (Haemonchus contortus).
Natural size.

Effect on Cattle.—The large stomach worm is the most serious parasite with which the cattle owner has to contend. Animals under 18 months old are chiefly affected and it is only rarely that adult animals are heavily parasitised by this species.

The worm is an active blood sucker and the effects of an infestation are principally those associated with loss of blood. The blood becomes thin and watery and the membranes of the eyes and mouth lose their healthy pink colour and become nearly white. The coat is dry and rough and a dropsical swelling develops under the jaw. Heavily infested animals rapidly lose condition and become weak. They show a disinclination to move about and stand in a dejected manner. The appetite usually remains good until shortly before death. Sometimes diarrhoea is profuse, particularly when many immature worms are present, but constipation may occur with mature infestations.

Brown Stomach Worm or Lesser Stomach Worm (Ostertagia ostertagi).

These are slender brownish worms (Plate 206), about half an inch long, which are found lying against the wall of the fourth stomach. Owing to their small size they can be easily overlooked. If the contents of the stomach are poured off and the walls washed lightly, the worms can be seen as fine brown streaks on the surface. They are generally most numerous near the opening of the stomach into the small intestine. A better method is to scrape the walls of the stomach and examine the scrapings in a glass dish held over a dark background.

Life History.—The pre-parasitic stages of the life cycle follow the general roundworm pattern. Following ingestion the larvae burrow into the walls of the stomach and lie coiled up in small, elevated, nodular areas. The lining of the stomach becomes inflamed and shows small pin-point haemorrhages. The larvae soon leave the nodules and continue their development on the mucosa.

Plate 206.

Brown Stomach Worm or Lesser Stomach Worm (Ostertagia ostertagi).
Natural size.

Effect on Cattle.—In many parts of the world the brown stomach worm is a serious parasite of cattle and may cause marked loss of condition, anaemia and diarrhoea. It is essentially a parasite of the cooler areas but is very common in southern Queensland. It may be sufficiently numerous on the Darling Downs to be pathogenic, or at least a contributing factor in outbreaks caused by other worms. Wet periods during the winter and early spring may lead to heavy infestation with these worms.

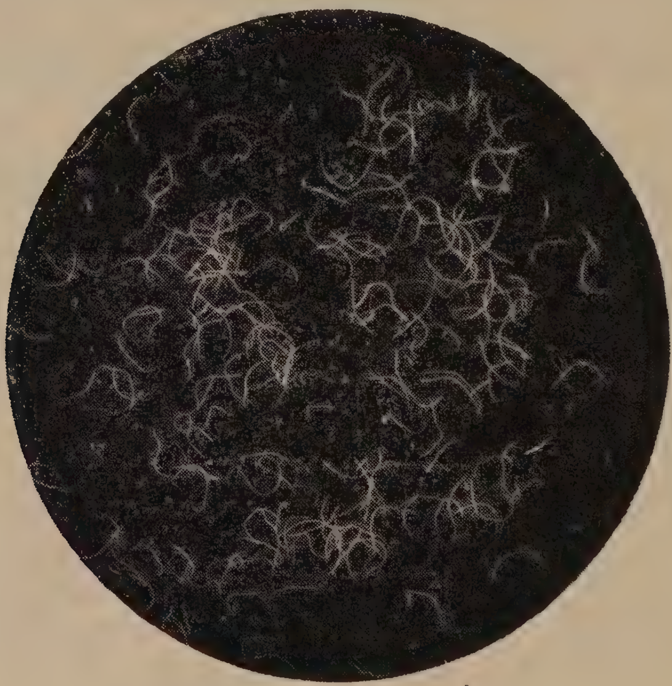


Plate 207.

Stomach Hair Worm (Trichostrongylus axei). Natural size.

Stomach Hair Worm (Trichostrongylus axei).

This is an extremely slender, reddish, hairlike worm (Plate 207) which rarely attains a length of more than a quarter of an inch. It is found in the fourth stomach in the same situations as the brown stomach worm. These worms are very fine and should be looked for in light scrapings from the walls of the stomach.

The life history differs only in small details from that of the larger stomach worm.

Though it is an important parasite of cattle in temperate countries such as England, it rarely becomes sufficiently numerous to be serious in Queensland. It is seen chiefly in the south-eastern areas and like the brown stomach worm may become important during wet winters.

Hookworm (Bunostomum phlebotomum).

This is a stout whitish worm (Plate 208) up to about an inch in length which occurs in the first few feet of the small intestine. The mouth of this worm is large and globular and has a number of teeth, by which it adheres firmly to the intestinal wall.

Plate 208.
Hookworm (Bunostomum phlebotomum). Natural size.

Life History.—The early part of the life history of the hookworm up to the development of the infective larvae in the pastures is similar to that of the stomach worms. Though some infection by the hookworm can occur when the larvae are swallowed, it most usually takes place by the larvae boring through the animal's skin. This can happen when any part of the animal's body comes in contact with soil or faeces containing hookworm larvae. Having penetrated the skin, the larvae reach the blood vessels and are carried to the lungs, where they undergo a period of development and then travel up the windpipe to the mouth and are swallowed. In the intestine they grow to maturity and start producing eggs about two months after first entering the animal.

Effect on Cattle.—The mouth structure of the hookworm makes it a serious blood sucker. A piece of the intestinal lining is drawn into the large globular mouth capsule and the teeth at the base of the capsule lacerate the tissues and the worm feeds on tissue and blood.

The effects of the hookworm are very similar to those of the large stomach worm. There is rapid loss of condition, anaemia and bottle jaw develop, and the animal may suffer from a diarrhoea in which the excreta is dark in colour.

Hookworm infestations are very serious in calves and relatively few worms can cause well marked symptoms, particularly when there are large stomach worms and large bowel worms also present.

Treatment and Control.—Hookworms in cattle are resistant to the majority of the drenches commonly used. Phenothiazine, even in heavy doses, may not remove the hookworms from every animal. Tetrachlorethylene is useful provided the drench goes direct to the fourth stomach. Unfortunately, there is no guarantee that pre-drenching with copper or sodium salts will bring this about by closing the oesophageal groove (see note on anthelmintics in a later section).

Hookworm infestation in young calves is generally associated with crowding of animals in small muddy calf pens and yards. The mixture of mud and faeces makes a good medium for the development of the infective larvae and the adhering qualities of this mixture allows easy entry of the larvae through the skin of the calves. Low-lying swampy areas have the same effect as muddy yards and lead to heavy hookworm infestation in older animals or in beef herds.

At present the control of hookworms must be based on preventive measures. Calf pastures and pens should be on high ground away from damp, swampy or muddy areas. In these circumstances, calves run on an extensive system acquire only a very light infestation, which is actually beneficial. A calf is able to throw it off by natural means and develops a fairly strong immunity as a result. Once this occurs, the calf very rarely acquires a pathogenic hookworm infestation at a later date.

Heavily parasitised animals should be drenched with phenothiazine twice at an interval of 14 days, placed on a clean pasture and given good supplementary food. The drenching will remove the other pathogenic species present and possibly some of the hookworms. The prevention of re-infestation coupled with a high plane of nutrition gives the calves a chance to throw off the infestation by natural means. A third drench in another 14 days may be desirable, for hookworms take about two months to mature in the calf and immature stages of all worms are more resistant to drenches than adults.

Small Intestinal Worm (Cooperia spp.).

These are small pinkish worms (Plate 209) up to a third of an inch in length which infest the first part of the small intestine. They are somewhat stouter than the stomach hair worms and if scrapings are taken from the intestinal wall and examined in a glass dish held over a dark background, these small intestinal worms may be readily seen.

Life History.—Their life history is similar to that of the stomach worms, cattle becoming infested when they swallow the infective larvae.

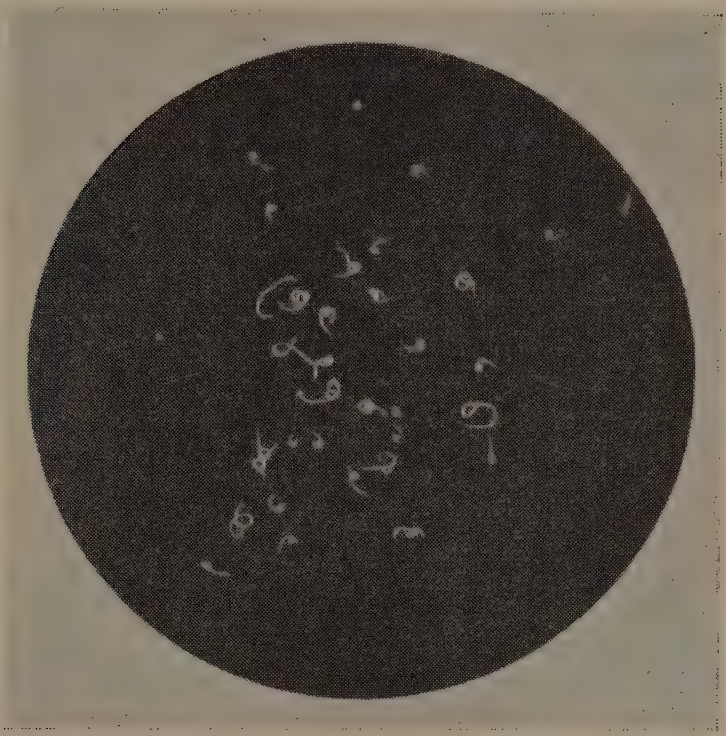


Plate 209.
Small Intestinal Worm (Cooperia spp.). Natural size.

Effect on Cattle.—Young calves are chiefly affected and may carry heavy infestation by the time they are three to four months old. However, the infestation is only temporary and is largely thrown off in two to three months.

In general, the worms are not considered pathogenic unless present in very large numbers. Anaemia is not a pronounced symptom nor is there any development of bottle jaw. Very heavy infestations have been associated with marked loss of condition and diarrhoea but it is suspected that many of these cases have some other complicating factor also present.

Treatment and Control.—These worms are resistant to phenothiazine, but treatment is rarely required. In cases of heavy infestation the calves should be drenched twice with phenothiazine at an interval of 14 days to remove other species of worms, allowing the calves to combat the small intestinal worms by natural means. Good supplementary feed and a change of pasture should also be provided. If the preventive measures outlined on page 362 are put into practice the animals are able to throw off their initial infestation without any symptoms developing.

Large Bowel Worm (Bosicola radiatus).

This is a stout, whitish worm (Plate 210) up to three-quarters of an inch in length which occurs in the first portion of the large bowel. The worms lie close against the bowel wall, sometimes burying their anterior ends into it and causing a conspicuous pitting.

Life History.—Larvae hatch from the eggs and develop in the manure in the usual way and then on being swallowed by cattle burrow deep into the intestinal wall, particularly of the large bowel or colon.

Later the worms return to the lumen of the large bowel, where they grow to maturity. Generally they reach maturity in five to six weeks after being swallowed, but the period may be considerably lengthened by the larvae being trapped in the bowel wall.

Effects on Cattle.—This worm is an extremely common parasite in Queensland, particularly in the coastal areas. When present in numbers in young stock, it causes anaemia, loss of condition and diarrhoea. The diarrhoea is a characteristic symptom, the dung being very watery and

Plate 210.

Large Bowel Worm (Bosicola radiatus). Natural size.

containing quantities of mucus. In very heavy infestations this mucus may be blood-flecked and may contain some worms. Large bowel worm infestations are generally complicated by concurrent large stomach worm and hookworm infestations.

The larvae when they burrow into the walls cause the formation of nodules. These are more conspicuous in older cattle and when in numbers may interfere with the movement of the bowel and so contribute to the general ill effects of an infestation. However, the nodule development is not so great as that caused by a similar type of worm in sheep.

In young stock heavy infestations with this parasite can be fatal, but should recovery occur the animal may remain stunted and unthrifty.

Whipworm (Trichuris spp.).

These worms resemble a whip (Plate 211); the anterior portion is long and slender like a lash and the posterior portion is short and stout like a whip handle. They are found in the caecum or blind gut, but occasionally, when a heavy infestation is present, extend a short distance into the large bowel.

The life cycle of this worm differs somewhat from that of the other roundworms. The eggs are passed out in the manure, and under favourable conditions a tiny larva develops inside the egg. However, the egg does not hatch until swallowed by an animal. The released larva then makes its way to the caecum, where it grows to maturity.

Plate 211.
Whipworm (Trichuris spp.) Natural size.

Though a common parasite of cattle, the whipworm is not considered harmful unless present in very large numbers. In Queensland this is a very rare occurrence.

No effective treatment is known and control rests entirely on preventive measures.

Lungworm (Dictyocaulus viviparus).

This is an elongate, slender, whitish worm (Plate 212) which grows up to three inches and more in length and is found in the small air tubes of the lungs.

Life History.—The eggs laid by the female in the lungs are coughed up and swallowed. On their way through the alimentary canal they hatch and the tiny larvae pass out with the droppings. Some eggs may be coughed out of the mouth in the sputum and saliva and hatch without passing through the animal.

Plate 212.

Lungworm (Dictyocaulus viviparus). Natural size.

After the usual period of development on the pasture they arrive at the infective stage and reach the host by way of its food and water. Once inside the animal they bore through the intestinal wall and reach the lymph nodes from which they are eventually carried to the lung. Here they make their way to the air tubes and grow to the adult stage.

Effects on Cattle.—Lungworms can be serious in young calves. A few worms do little harm but when present in numbers they cause frequent coughing and difficulty in breathing. The animal becomes weak and listless and frequently suffers from diarrhoea. Bunches of worms are frequently coughed up in a quantity of bloodstained frothy material. Eventually the breathing rate becomes very rapid and the animal may die.

The main effects of lungworms are a mechanical blocking of the air tubes and an irritation that may lead to pneumonia.

Treatment and Control.—Lungworm disease of cattle is usually associated with two factors—poor nutrition and a heavy infestation of other worms. The following treatment is therefore indicated:—

(1) Remove affected animals from the pasture in which they have been running and provide them with warm quarters and nutritious feed.

(2) Drench twice with phenothiazine at an interval of 14 days. This drench has no direct effect on the lungworm but removes most of the other pathogenic species in the alimentary tract and enables the animal's resistance against the lungworms to be increased.

In most cases if these two measures are put into practice, outbreaks can be controlled.

The only other treatment available is an injection of drugs into the windpipe by means of a sterilized hypodermic syringe. However, this treatment is not always successful and is not recommended. The operation is not an easy one and should be carried out under the supervision of a Stock Inspector or some other experienced person. A formula employed is as follows:—

Turpentine	1 drachm
Glycerine	1 drachm
Chloroform	$1\frac{1}{2}$ drachms
Carbolic acid	10 minims

The general preventive measures outlined on page 362 if put into practice will do much to control lungworm. Special attention should be given to the avoidance of damp pastures for calves, as these favour the development and survival of lungworm larvae.

Beef Nodule Worm (Onchocerca gibsoni).

This is an extremely common parasite of cattle in Queensland. It is found in nodules, chiefly in the brisket and stifle regions. The nodules vary from the size of a pea up to something of the order of five inches in diameter. Each nodule contains a female and one or more male worms and if cut open these may be seen inside intricately tangled up in the tissues (Plate 213). The worms themselves are slender and very fragile. The female may measure up to 20 inches and more in length and the male up to four inches.

Plate 213.

Beef Nodule Cut Open to Show the Intricately Coiled Worm Inside.

Life History.—The life history has not been worked out in this country but studies in Malaya show that it is spread by certain species of sandflies. The eggs which hatch in the nodule give rise to tiny larvae known as microfilariae. These leave the nodule and are found in the lymph spaces in the skin. When these sandflies attack cattle they ingest the microfilariae, which then undergo a necessary part of their development in the sandfly. When an infected fly bites another bovine the larvae are liberated and eventually penetrate the host's skin. After moving around for some time they settle down in the brisket and stifle, and as a result of their presence here the tissues around them gradually form a nodule.

Effects on Cattle.—The beef nodule worm does not appear to be harmful in any way to cattle. The presence of nodules in the brisket is, however, not desirable and this portion of the carcase has to be boned and examined for nodules before being exported.

Control.—It is impossible to remove the adult worms from an animal and any control measures must be directed against the sandflies that spread the parasite. These tiny flies breed in a variety of situations, such as mud, rotting vegetation, manure heaps, etc., and under the conditions present in the areas where cattle become infested control of these flies does not appear at the present time to be feasible.

CONTROL OF PARASITIC DISEASES.

Under normal conditions it is impossible to maintain animals completely free from worms. Much can be done, however, to prevent these parasites from becoming sufficiently numerous to endanger the animal's health. Even when medicinal treatment is efficient it should never be relied upon as the sole means of keeping the infestation at a low level. This applies particularly to cattle, for unfortunately little is known of the efficiency of many of the drugs that have been used on them for the removal of worm parasites. The cattle owner should endeavour to use preventive measures as a means of keeping his stock healthy and to use medicinal treatment only as an adjunct to these measures.

Preventive Measures.

Preventive measures are designed to reduce the chances of the animals becoming infested. They are based upon a knowledge of the life histories of the worms and of the conditions in a pasture which favour the development and survival of worm eggs and larvae. The period spent outside the host is a "weak link" in the life cycle of a parasite and it is against this "link" that preventive measures are applied.

Everything possible should be done to reduce the chance of an animal picking up large numbers of infective larvae and thus becoming heavily parasitised.

Adult cattle are reasonably resistant to worms, while calves and yearlings are most susceptible. The younger animals should be given primary consideration when putting preventive measures into operation.

Calf Pen Hygiene.—Small calf pens, often used during the first few weeks of an animal's life, must be kept as clean and dry as possible, for they are often a source of heavy worm infestation, as well as other common calfhood diseases. The mixture of mud and faeces makes an ideal medium for the development of hookworm larvae, and as it adheres

very well to the feet and body of the calf, ingress of larvae through the skin is made easy. A mixture of mud and faeces from swampy areas may lead to hookworm infestation of older animals.

Rate of Stocking.—The stocking rate of young stock should be as light as possible. The more animals there are on a pasture the more the pasture becomes contaminated with larvae and the greater are the chances of an animal becoming heavily infested. In dairying districts a high stocking rate cannot always be avoided, but this can be compensated for by improved pasture to raise the standard of nutrition and by efficient management so that adequate spelling is possible.

In beef herds, local overcrowding of animals on creek frontages, gullies or damp areas has the same effect as overstocking, even though the overall stocking rate of the paddock may be low. Many outbreaks amongst beef weaners run on the extensive system have been associated with local overcrowding in the situations mentioned.

Calf Pastures.—Permanent calf pastures for calves and young stock should be avoided. The retention of animals for long periods in a small calf paddock leads to heavy contamination of the area with droppings and a resultant increase in the number of infective larvae available to the animal. These permanent calf pastures become eaten out and the animals are forced to graze closer to the ground and then the rate of intake of infective larvae is greatly increased. This applies even when supplementary feeding is practised. The animals are continually becoming infested but may not show clinical symptoms of parasitism until they receive some check later in life.

Any system of rotational grazing whereby a pasture can be used for 1-2 weeks and then spelled for 4-6 weeks is beneficial in preventing outbreaks of parasitism. The pasture can be grazed by horses while spelling, for the worms of horses do not affect cattle and vice versa.

Damp, low-lying and swampy areas should not be grazed by young stock for the moisture favours the survival of infective larvae. Swampy areas are an important source of food in dry times but the heavy faecal contamination these areas receive greatly increases the chances of gross parasitism. If these areas must be used it is advisable to carry out anthelmintic treatments at regular and frequent intervals before the young stock show symptoms of parasitism.

Nutrition.—Nutrition plays an important part in the prevention and control of worm parasites. Animals in good condition and receiving adequate feed are often able to throw off an infestation by natural means. This factor is used in the treatment of lungworms and hookworms, where drenching is not always successful. Animals on a high plane of nutrition are able to stand a moderate worm burden, but as soon as the nutritional plane is lowered they start to show the effects of worms. Outbreaks of parasitism are relatively few during a normal summer in Queensland when pastures are at their best, but during the winter, when the pastures are falling off, outbreaks are common and widespread. When anthelmintic treatment is given to heavily infested animals they often fail to show the improvement expected, because, though most of the worms may have been removed, the animals are unable to obtain sufficient nourishment from a poor pasture to repair the damage caused by the worms.

Supplementary feeding can play an important part in controlling parasitism if applied during periods of the year when pastures are poor and animals have been treated for worms.

There is evidence that mineral and trace element deficiencies may be associated with increased parasitism in cattle. The significance of this is not known at present but is suspected in several areas in Queensland. When any mineral deficiency is known to occur in an area it is advisable that the young stock be given access to licks containing the deficient elements.

Anthelmintic Treatment of Roundworms.

The aim of anthelmintic treatment should be preventive rather than curative. Parasitism in calves can be very slow in its onset and if treatment is delayed until the animals are visibly wormy disappointing results are often obtained.

In areas when parasitism can be expected it is advisable to drench early—that is, before the worm burden, coupled with a falling plane of nutrition, leads to symptoms of parasitism. Under Queensland conditions the bulk of the worm infestation is picked up during the summer and early autumn so that three treatments are required—namely, during February-March, June-July and September-October. The first treatment is to remove principally the large stomach worms picked up during the summer. The second is designed to remove the bulk of the worms picked up during the rainy season and the adult large bowel worms which have left the bowel wall since the last drenching. These two treatments are very important, for it is desirable that the calves go into the winter as free as possible from worms. The third treatment in the spring is directed mainly against the large bowel worm. In areas which receive heavy spring rains a further treatment will be desirable before the February-March period.

In beef herds it may not be necessary to give more than two treatments while the calves are with their mothers—the first in February-March and the second at the time of weaning. If weaning is delayed till late in the year the June-July treatment is desirable. The setback associated with weaning often produces very susceptible animals and outbreaks of parasitism are likely to occur a few months after weaning. For this reason the calves should be drenched when they are taken from their mothers and before being placed in the weaning paddock.

Beef weaners are still susceptible to worm infestations during the summer and autumn following weaning and must be watched carefully and treated at the first signs of parasitism.

Every calf in a herd should be treated and not only those that appear wormy. Untreated calves, though they appear healthy, may be carrying a moderate worm burden. If these are placed on a clean pasture with the treated animals they act as a source of contamination of the pasture with larvae. These apparently healthy animals may show symptoms of parasitism at a later date.

Drenched calves must be placed immediately on a pasture that has not been grazed by cattle for some time. Drenching may remove the majority of the worms present in the animals but the calves are still susceptible to worms. If they are returned to the old pasture they will quickly acquire a new infestation. This is particularly important with animals that have shown clinical symptoms before drenching. These animals are very susceptible to reinfestation and will not improve unless reinfestation is prevented and they are given nutritious food to repair the damage caused by the worms.

Animals showing marked clinical symptoms of parasitism should be drenched twice at 14-day intervals with a change of pasture after each drenching. The majority of the drenches used are not particularly effective against immature stages, so the second treatment is required to remove the worms that were immature at the time of the first treatment.

Anthelmintics in Use.—Very little critical work has been done in the study of anthelmintics for cattle. The majority of the drenches used have their recommendations based on their efficiency against sheep roundworms.

Phenothiazine is the best drug for cattle roundworms. It is very efficient against the large stomach worm (*Haemonchus contortus*) and the large bowel worm (*Bosicola radiatus*) and moderately efficient against the smaller stomach worms (*Ostertagia* spp. and *Trichostrongylus axei*). It is not always efficient against the hookworm (*Bonostomum phlebotomum*) and the small intestinal worm (*Cooperia* spp.).

Copper sulphate, alone or in combination with arsenic or nicotine sulphate, has been used for stomach worms, and tetrachlorethylene, preceded by copper sulphate or baking soda, for stomach worms and hookworms. For these drenches to be effective they must go direct to the fourth stomach. If they are swallowed into the rumen or paunch they become so diluted that by the time they reach the fourth stomach they are not effective in removing worms.

Phenothiazine.—Phenothiazine is not soluble in water but is available as a wettable powder that can be suspended in water or as an already prepared suspension. The powder can be given in the feed of stall-fed animals but it is more conveniently given as a drench. The dose rate of the powder form is as follows:—

Animals	2 to 4 months	½ oz. phenothiazine
	4 to 6 months	¾ oz. ,,
	6 to 12 months	1 oz. ,,
	12 to 18 months	1½ oz. ,,
	over 18 months	2 oz. ,,

To prepare a drench, weigh out the total amount of phenothiazine required to treat all the animals in the herd. Pass the powder through a sieve to remove all lumps (a kitchen sifter is very suitable for this purpose). Measure out 12 fluid ozs. of water for each pound of phenothiazine. Pour the water on to the powder gradually, stirring vigorously to form a thin paste. When used in this form the amounts to be given are as follows:—

Animals	2 to 4 months	¾ fluid oz.
	4 to 6 months	1⅛ fluid oz.
	6 to 12 months	1½ fluid oz.
	12 to 18 months	2¼ fluid oz.
	over 18 months	3 fluid oz.

The above suspension is in some quarters considered to be too thick to use without some difficulty. A thinner suspension may be made by weighing out the quantity of phenothiazine required to treat the animals and placing it in a container graduated in fluid ounces. A little water is added to form a paste and finally more water is added until there are twice as many fluid ounces of suspension in the container

as ounces (weight) of powder used. Each fluid ounce of this suspension will contain half an ounce (weight) of the powder. The dose rate will then be as follows:—

Animals 2 to 4 months	.. ..	1 fluid oz.
4 to 6 months	.. ..	1½ fluid oz.
6 to 12 months	.. ..	2 fluid oz.
12 to 18 months	.. ..	3 fluid oz.
over 18 months	.. ..	4 fluid oz.

The above method is suitable when small numbers of animals are to be treated and odd fractions of a pound of the powder are to be used.

The mixture, particularly the thin type, must be kept well stirred during drenching or the phenothiazine will sink to the bottom. The drench may be given with a drenching gun or drenching funnel. There are drenching guns specially designed for phenothiazine. These may clog after some use but this can be avoided by frequent washing with water and keeping the plunger well lubricated with liquid paraffin.

Phenothiazine is a very safe drug to use on cattle. Starvation before or after treatment is not required. The urine may be stained red for some days but this is of no importance as it is due only to an oxidation product of the drench and not to the presence of blood pigments.

An eye condition resembling blight often follows the use of phenothiazine but this effect soon disappears. The condition is due to the action of bright sunlight on a phenothiazine derivative present in the eye 12 to 36 hours after drenching. The condition can be prevented entirely if the animals are kept in complete shade the day after drenching. Small numbers of calves on dairy farms may be enclosed in barns and sheds and beef calves confined in heavily shaded paddocks.

Tetrachlorethylene.—This drug is available commercially as a mixture of equal parts of tetrachlorethylene and liquid paraffin or as an emulsion. The drench is given immediately after 4 oz. (half a cup) of a 5 per cent. solution of baking soda (half a pound of baking soda in one gallon of water). The baking soda is to close the oesophageal groove and allow the drench to go direct to the fourth stomach. This is based on recommendations of workers in South Africa. There is some doubt, however, as to the efficiency of sodium or copper salts in closing the groove. If the groove does not close the drench will pass into the paunch and be ineffective. Tetrachlorethylene treatment should only be attempted in cases of hookworm infestations that do not respond to phenothiazine. (See notes on hookworms given earlier).

The dose rate of a 50 per cent. mixture of tetrachlorethylene and liquid paraffin is as follows:—

Animals 2 to 4 months ..	..	20 to 30 c.c. of the mixture
4 to 8 months ..	..	30 to 40 c.c. „ „ „
8 to 12 months	..	40 to 50 c.c. „ „ „
12 to 18 months	..	50 to 60 c.c. „ „ „

Tetrachlorethylene has a low toxicity for cattle but some animals immediately after drenching develop a staggering gait, become giddy and may even fall down. This intoxication is only temporary and the calves are back to normal in a few minutes.

Repairing a Galvanised Iron Tank.

F. MANUELL, Agriculture Branch.

THE writer has successfully repaired badly-holed 1,000-gallon galvanised iron water tanks by the method given here.

First check your tank stumps and stand. Be sure your stumps are not rotten at the bottom and that your stand is level and firm.

Materials and Tools Required.

Five bags of cement and half a yard of plaster sand will cement a 1,000-gallon tank (two coats), including the cement creaming.

A large whitewash brush or an old paint brush.

A wire brush.

A large hand trowel (about 9 inches).

A small hand trowel (4 inches).

A short-handled shovel for mixing material.

Several buckets.

A steel or wooden float is handy, but not essential.

Two high ladders and a long plank, or similar scaffolding, are a great help when cementing inside the tank.

Arrange the ladders and plank so that the plank is about one inch above the outer edge of the opening on top. You can then use a short ladder resting on the inside bottom of the tank and leaning against the edge of the top plank to enable you to climb into the tank without disturbing the cement work. Another ladder from the ground and leaning against the outer edge of the plank will be necessary to climb up to the plank, if the tank is on high stumps.

The cementing material can be mixed outside the tank and carried up, or taken into the tank in the dry state and mixed on the bottom of the tank (the latter method is the better).

A large tarpaulin to put right over the tank (excluding the opening at the top) is a great advantage. It keeps the sun off the side of the tank and keeps the inside cool while working.

Cleaning the Tank.

Empty the tank, and shut off any water which might run into it from the roof. To facilitate working inside the tank, it is advisable to open the top crimped edge or cut a large semi-circular opening on the top of the tank (with tinsnips) and bend this cut portion back, instead of climbing in and out through the opening where the water normally runs into the tank. (This cut opening can be closed and soldered up when the cementing is finished.)

Clean out the tank thoroughly, removing all scale rust with a scraper and a wire brush. If there are any large holes in the sides of the tank, patch them with bird wire. Disregard any small holes (the cement will fill these up) and put a cork or wooden plug into the pipe at the bottom of the tank to prevent any cement getting into it. If there is any buckling on the inside bottom of the tank (and there usually is), drive some large-headed clouts through the bottom of the tank into the stand to make the bottom firm.

The First Coat.

Commence by putting a creamy coat of cement and water (creaming to be about as thick as pea soup), all over the inside walls of the tank. This first coat of creaming will dry very quickly.

Then mix 2 parts of plaster sand (or other very fine, clean sand) with 1 part of cement. An ordinary household bucket makes a good measure for this work. Mix the sand and cement thoroughly in the dry state before adding any water. When thoroughly mixed, add only sufficient water to make the mixture workable (not sloppy).

The first coat of creaming on the walls will be dry, so give a small section on the top inside another coat of creaming, and start putting on the cement mixture. The surface of the wall you are working on *must* be wet with the creaming mixture to allow the cement mixture to stick properly, so keep about half a bucket of creaming handy to wet each section as you apply the mixture (stir the creaming in the bucket frequently). A good method is to work around the inside top, putting a circle about 12 inches wide right round, then another circle right round just below the first circle, and so on down to the bottom.

When putting the cement mixture on, be *sure* and press it firmly into the corrugations of the tank and the bird wire, if the tank has been patched.

When the sides are finished, start on the bottom. A good method is to cream and cement about one-third of the bottom in one section, then one-third again on the opposite side, leaving a strip about 2 feet wide down the centre bottom. Let those two strips dry until hard enough to stand on (say about 12 hours) then cream and cement the centre strip (a wide board is useful to put on top of the cemented portion to stand on). Make this cemented bottom no less than one inch thick, and both the walls and bottom should be left with a rough surface, so that the second coat will stick well on to the first coat.

The Second Coat and Sealer.

Allow the first coat to harden (any time after about two days) then apply the second coat. Just before applying the second coat, wet the surface of the first coat with clean water (this will dry quickly).

For the second coat use 1 part of sand to 1 part of cement. Mix the sand and cement thoroughly in the dry state, then add the water. Mix thoroughly again, then start at the top again. Give the first coat a creaming of the cement and water, and put on the second coat right round the top (about 12 inches wide), covering the inside corrugations with about half an inch of cement mixture, then another circle below the first, and continue in circles down to the bottom. Press the second coat on to the first coat, and smooth off the surface as it becomes dry enough to smooth.

Don't forget to give each section a creaming just before you put on the cement mixture.

When the inside walls are finished, give the bottom a creaming coat and put the second coat on the bottom, about half an inch thick, in three sections of one-third each. When the second coat has been smoothed off and has set (about two days), give the sides and bottom two coats of creaming and follow this with two coats of alum water sealer at 24-hour intervals between the applications. (Use 1 lb. alum to 4 gallons of water. Dissolve alum in very hot water and apply while hot.)

When the cemented tank is filled with water after rain, the water is hard, owing to the alum wash. However, this hardness will disappear after the tank has been emptied and refilled with rain water.

Another method which can be used to seal the finished job is to incorporate the sealing material with the sand and cement when the second coat is being mixed. Waterglass (sodium silicate) can be added to the water in the mixing (1 part of waterglass to 12 parts of water).

Brucellosis Testing of Swine.

The Department of Agriculture and Stock is operating a scheme whereby pig herds are tested at intervals for the occurrence of swine brucellosis (contagious abortion).

A herd listed by the Department as "brucellosis tested" is one in which all such animals as may be determined by the Director of the Department's Division of Animal Industry have been subjected to two successive tests for brucellosis, at intervals determined by him, without any positive reactors being found.

In order for a herd to be retained on the list of Tested Herds, a semi-annual or annual re-test of the herd, as determined by the Director, is required. If at a re-test any animal gives a positive reaction to the test the herd is removed from the list; it is not listed again until subsequent tests, as determined by the Director, have been carried out.

Full particulars of the Brucellosis Testing of Swine and application forms may be obtained from the Under Secretary, Department of Agriculture and Stock, William Street, Brisbane.

TESTED HERDS.

(AS AT 23rd NOVEMBER, 1951.)

Breed.	Owner's Name and Address of Stud.
Berkshire	S. S. Ashton, "Scotia" Stud, Pittsworth
	J. J. Bailey, "Lucydale" Stud, East Greenmount
	S. Cochrane, "Stanroy" Stud, Felton
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	G. Handley, "Handleigh" Stud, Murphy's Creek
	J. L. Handley, "Meadow Vale" Stud, Lockyer
	R. G. Koplick, "Melan Terez" Stud, Rochedale
	H. V. Littleton, "Wongalea" Stud, Crow's Nest
	O'Brien and Hickey, "Kildurham" Stud, Jandowae East
	E. Pukallus, "Plainby" Stud, Crow's Nest
	G. C. Traves, "Wynwood" Stud, Oakey
	E. Tumbridge, "Bidwell" Stud, Oakey
	Westbrook Farm Home for Boys, Westbrook
	H. W. Wyatte, Rocky Creek, Yarraman
	H.M. State Farm, "Palen Creek," Palen Creek
	A. R. Ludwig and Sons, "Cryna" Stud, Beaudesert
	H. H. Sellars, "Tabooba" Stud, Beaudesert
	F. Thomas, "Rosevale" Stud, Beaudesert
	Bowkett and Meacle, "Myola Vale" Stud Piggery, Burra Burri, Jandowae
	D. T. Law, Trouts Road, Aspley
	R. J. McCullough, "Maxholm" Berkshire Stud, Gatton
	C. F. W. and B. A. Schellback, "Redvilla" Stud, Kingaroy
	R. H. Crawley, "Rockthorpe" Stud, via Pittsworth
Large White	H. J. Franke and Sons, "Delvue" Stud, Cawdor
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	F. L. Hayward, "Curyo," Jandowae
	J. A. Heading, "Highfields," Murgon
	K. B. Jones, "Cefn" Stud, Pilton
	R. G. Koplick, "Melan Terez" Stud, Rochedale
	R. Postle, "Yarralla" Stud, Pittsworth
	E. C. Smith, "Smithfield" Stud, Coomera
	E. J. Bell, "Dorne" Stud, Chinchilla
	A. G. Fry, "Birubi" Stud, Dalby
	N. E. Meyers, Halpine Plantation, Kallangur
	L. C. Lobegeiger, "Bremer Valley" Stud, Moorang, via Rosewood
	J. H. G. Blakeney, "Talgai" Stud, Clifton
	V. P. McGoldrick, "Fairymeadow" Stud, Cooroy
	N. Woltmann and Sons, Wooroolin
	R. S. Powell, Kybong, via Gympie

TESTED HERDS—continued.

Breed.	Owners Name and Address of Stud.
Tamworth	S. Kanowski, "Miecho" Stud, Pinelands N. R. Potter, "Actonvale" Stud, Wellcamp D. F. L. Skerman, "Waverley" Stud, Kaimkillenbun A. C. Fletcher, "Myola" Stud, Jimbour L. C. Lobegeiger, "Bremer Valley" Stud, Moorang, via Rosewood Salvation Army Home for Boys, Riverview F. Thomas, "Rosevale" Stud, Beaudesert A. J. Surman, Noble Road, Goodna P. V. McKewin, "Wattleglen" Stud, Goombungee Department of Agriculture and Stock, Regional Experiment Station, Kairi
Wessex Saddleback . .	W. S. Douglas, "Greylight" Stud, Goombungee K. Day and P. Hunting, "Kazan" Stud, Goodna E. Sirrett, "Iona Vale" Stud, Kuraby C. R. Smith, "Belton Park" Stud, Nara H. H. Sellars, "Tabooba" Stud, Beaudesert H. Thomas, "Eurara" Stud, Beaudesert D. T. Law, Trouts Road, Aspley G. J. Wilson, "Glenbella" Stud, Silverleigh G. J. Cooper, "Cedar Glen", Yarraman J. B. Dunlop, Acacia Road, Kuraby

ASTRONOMICAL DATA FOR QUEENSLAND.

JANUARY.

Supplied by W. J. NEWELL, Hon. Secretary of the Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			MINUTES LATER THAN BRISBANE AT OTHER PLACES.					
Day.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	4·56	6·46	Cairns ..	48	9	Longreach	43	27
6	5·0	6·47	Charleville ..	29	25	Quilpie	33	37
11	5·04	6·47	Cloncurry	63	36	Rockhampton ..	18	2
16	5·08	5·47	Cunnamulla ..	28	31	Roma	19	15
21	5·12	6·46	Dirranbandi ..	16	22	Townsville ..	40	9
26	5·16	6·45	Emerald	27	12	Winton	51	30
31	5·20	6·43	Hughenden ..	48	22	Warwick	2	6

TIMES OF MOONRISE AND MOONSET.

At Brisbane.

Day.	Rise.	Set.
	a.m.	p.m.
1	8·44	9·55
2	9·49	10·29
3	10·50	11·01
4	11·50	11·32
	p.m.	
5	12·48	..
		a.m.
6	1·46	12·05
7	2·44	12.40
8	3·42	1·19
9	4·38	2·02
10	5·31	2·50
11	6·19	3·43
12	7·02	4·37
13	7·40	5·34
14	8·14	6·29
15	8·44	7·24
16	9·13	8·18
17	9·41	9·11
18	10·09	10·05
19	10·40	11·00
20	11·14	11·58
		p.m.
21	11·53	1·00
22	..	2·06
	a.m.	
23	12·41	3·14
24	1·37	4·21
25	2·42	5·24
26	3·54	6·19
27	5·07	7·07
28	6·20	7·48
29	7·28	8·25
30	8·34	8·58
31	9·37	9·31

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

Charleville 27; Cunnamulla 29; Dirranbandi 19; Quilpie 35; Roma 17; Warwick 4.

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Day.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	24	15	40	31	15	7	46	35
6	13	25	28	41	2	16	31	48
11	9	30	25	45	0	21	26	54
16	17	23	32	39	8	14	37	44
21	28	12	44	27	19	2	51	30
26	30	11	45	25	20	0	53	28
31	17	22	33	38	8	13	37	44

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	41	21	57	44	42	29	34	18
3	28	32	50	53	34	38	24	28
5	18	43	42	59	27	45	16	36
7	8	48	36	62	21	48	8	40
9	2	55	33	67	17	52	3	45
11	3	56	34	67	18	53	4	46
13	10	50	37	63	22	49	9	42
15	19	42	42	59	27	44	17	36
17	29	32	50	53	35	38	25	28
19	39	21	56	44	41	29	33	18
21	50	10	64	37	48	23	41	10
23	54	3	67	32	51	18	44	4
25	56	3	68	32	52	18	46	4
27	50	11	64	38	48	23	41	11
29	37	24	55	46	40	31	31	21
31	25	36	47	55	32	40	21	31

Phases of the Moon.—First Quarter, January 4th, 2.42 p.m.; Full Moon, January 12th, 2.55 p.m.; Last Quarter, January 20th, 4.09 p.m.; New Moon, January 27th, 8.26 a.m.

On January 4th the sun will be at its nearest approach to earth (91,400,000 miles). On the 15th it will rise and set 23 degrees south of true east and true west respectively. The moon will rise and set at true east and true west respectively on 3rd, 17th and 30th.

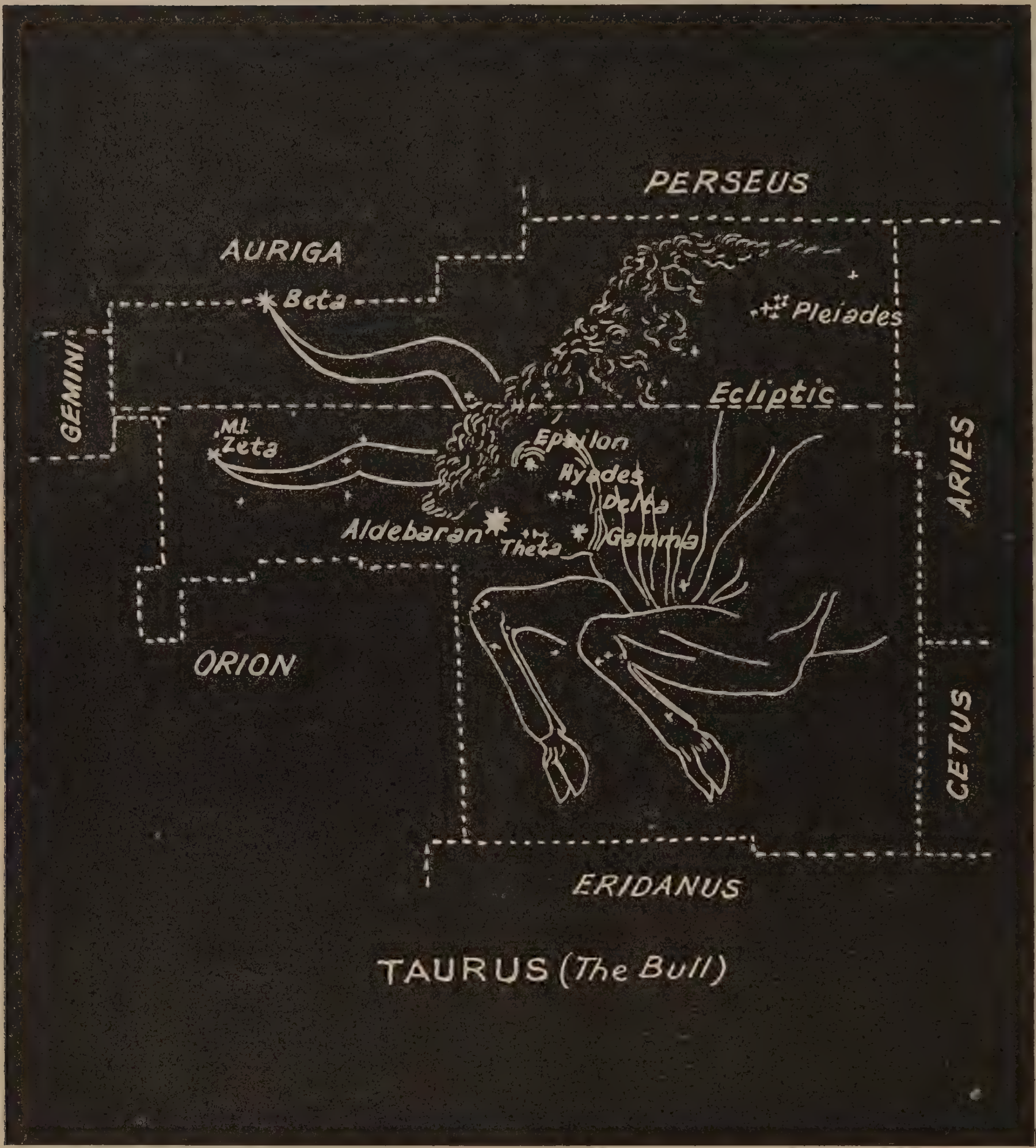
Mercury.—A morning object all this month. At the beginning, in the constellation of Ophiuchus, it will rise about 1½ hours before sunrise and at the end of January, in the constellation of Sagittarius, it will rise 1 hour 11 minutes before sunrise.

Venus.—This month will rise about 2¾ hours before the sun. At the beginning of the month it will be situated in the constellation of Libra and after passing through the constellations of Scorpio and Ophiuchus will be placed in the constellation of Sagittarius at the close of the month.

Mars.—In the constellation of Virgo, will rise near midnight at the beginning of the month, when it will be situated near Spica. At the end of the month it will rise about 1 hour before midnight.

Jupiter.—At the beginning of the month will set near midnight but at the end of the month it will set between 9.45 p.m. and 11 p.m. On the 3rd and 31st the moon will be situated near this planet.

Saturn.—Situated in the constellation of Virgo, it will rise near midnight at the beginning of the month, not far from Mars; but at the end of January it will rise between 10 p.m. and 11.15 p.m.



THE CONSTELLATIONS.

TAURUS—THE BULL.

This is one of the constellations of the Zodiac and is sometimes said to represent the bull of mythology which swam away from Europa, but the form of a bull was probably given to the group by the Babylonians. The constellation possesses two magnificent clusters in the Hyades and the Pleiades. The Hyades cluster looks like a huge A lying obliquely across the sky with gamma Tauri at the apex, Epsilon Tauri at the left foot and Aldebaran (Alpha Tauri) at the right foot. Aldebaran a bright reddish 1st magnitude star, has a faint 11th magnitude companion about 120 seconds away. Between Aldebaran and Gamma are Theta 1 and 2, easily seen as a pair with the naked eye. On the other leg, between Epsilon and Gamma, are the Deltas 1, 2 and 3.

To really appreciate this group it should be examined with field glasses or a wide field telescope. The Pleiades, known to most people as the Seven Sisters, is a fine compact group that immediately catches the eye. Most people can see 6 stars in the group with the unaided eye but some with acute vision have claimed to see as many as 9. Actually the Pleiades are immersed in nebulous matter which is very evident on long exposure photographs of the group. Seven of the bright stars of the group are named Alcyone (Eta) Celeone, Electra, Maia, Merope, Asterope, and Taygeta, after the daughters of Atlas and the nymph Pleione. Two others in the group are named after Atlas (27 Tauri) and Pleione (28 Tauri). Many doubles will be seen in this group when examined with a telescope. Old star maps show the Hyades as the head of the bull, with Aldebaran as the eye. A line from Gamma through Aldebaran produced 5 times brings the eye to Zeta at the tip of one horn and a line from Gamma through Epsilon points to Beta on the other horn. About one degree north of Zeta will be found M1, "The Crab Nebula". It is a faint gaseous nebula, the outline being visible only in large telescopes. It was discovered in 1731 but was forgotten and rediscovered by Messier in 1758, which led him to make his catalogue of 103 clusters and nebulae, hence its designation in his list as M1.

[*Supplement to the "Queensland Agricultural Journal," January*, 1951.]

QUEENSLAND.
DEPARTMENT OF AGRICULTURE AND STOCK.

Pure Bred Production Recording.

REPORT FOR THE YEAR 1949-50.

By S. E. PEGG, Q.D.A.,
Senior Adviser (Herd Recording),
Division of Dairying.

Issued by direction of
The Hon. H. H. COLLINS, M.L.A.,
MINISTER FOR AGRICULTURE AND STOCK.

COVER PICTURE

A Group of Daughters of the Jersey Sire, Devon Park Madeira's Victorious, owned by Mr. F. Porter, Cambroon, Mary Valley.

[*Photo. by Queensland Country Life.*

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A. H. TUCKER, Government Printer, Brisbane.

FOREWORD.

★ ★

The decision to publish annually in one cover the performances of cows officially recorded under the Pure Bred Production Recording Scheme was made this year, and marks the beginning of providing a permanent and easily accessible record of the performances of some of our pure bred stock.

Breeders have expressed a desire for an annual publication of records, and this publication is in line with the policy of my Department for the fullest development of the Pure Bred Production Recording Scheme. It contains valuable basic information to aid the buyer seeking a sire to improve the production of his stock.

As time passes and more information is obtained, this publication will embrace the results of sire surveys and a register of merit for cows. This information will further enhance the value of the publication and allow the selection of superior producing strains for breeding purposes.

It is my hope that this report will prove an incentive to breeders already in the Pure Bred Production Recording Scheme, and that it will encourage others to join. Intelligent application of its facts should contribute towards a general uplift in the production of the dairy herds of this State.

Breeders should realise that the majority of the bulls in use in the commercial dairy herds come from pedigreed herds. Therefore, it is essential that the producing quality of the pedigreed herds be maintained at a level appreciably higher than that of the average grade herd in the industry under the same environmental conditions.

The basis of all herd improvement is continuous herd production recording. This, coupled with continuous, intensive selection and the use of all other available means for improving the quality and productivity of pedigree stock, can aid materially in attaining the desired objective of ensuring that pure-bred herds are superior in production to the ordinary commercial herds of the State.

H. H. COLLINS,
Minister for Agriculture and Stock.

Pure Bred Production Recording, 1949-50.

PRODUCTION recording of pure-bred dairy cattle commenced in Queensland in 1916. At that time the standard for entry into the Advanced Register of the herd books of the various dairy cattle societies was based on a 48-hour record. This was eventually changed, as it was realised that a short-period production record was of little value in assessing the productive ability of a cow during a full lactation period.

In 1920, a 273 days lactation period was introduced, and this has remained in force up to the present. Under this scheme, cows yielding specified minimum quantities of butterfat, according to age, are admitted into the Advanced Register. The minimum standards prescribed are:—

Age.	*Butterfat.* lb.
Junior 2	230
Senior 2	250
Junior 3	270
Senior 3	290
Junior 4	310
Senior 4	330
Mature	350

The primary aim of this scheme was to raise the standard of production in commercial herds by encouraging the use of production-bred pedigreed bulls. Until recently, emphasis was placed on the dam with a high production record as the best animal to raise a sire of productive progeny. Experience has shown that like does not always produce like when production is the criterion, but that the production of progeny of a high producing cow has a tendency to revert to the herd average.

Emphasis has now changed from the cow to the sire, a major aim of most recording schemes to-day being to find the sires which prove themselves capable of begetting high-producing daughters. This has led to the establishment of sire surveying in the leading dairying countries of the world, namely, New Zealand, Holland, Denmark, the United States, and Great Britain. The Queensland Department of Agriculture and Stock is at present giving consideration to the introduction of a sire surveying scheme. The implementation of the scheme has been delayed by the fact that most breeders have been recording a few selected animals for one lactation period only, and not continuously recording all the animals in the herd.

In order to assist the projected sire surveying, revised rules governing the Pure Bred Production Recording Scheme were brought into operation on 1st July, 1949. Breeders entering the scheme are now required to submit at least one-third of their herds for recording, including all cows on their first calf. This ensures that a reasonably large sample of a bull's daughters is recorded and thus establishes a basis for assessing his value.

So that all interest in the individual cow will not be lost, it is the intention to establish a Register of Merit for cows which show a required standard of production in three successive lactations. This register will be useful in ascertaining which families of cows are capable of producing at a high level over a number of years, calving regularly and resisting disease.

Herds and Cows Being Recorded.

The numbers of herds of the various breeds which have been recorded since 1947-48 are shown in Table 1. In connection with the figures for 1949-50, it should be noted that when the revised rules were introduced, cows being recorded under the old rules completed their records under those rules.

In some districts, the number of herds accepted for recording in 1949-50 had to be restricted so as not to interfere unduly with the advisory work of field officers. This resulted in the rejection of twelve herds for which applications were received, and there is reason to believe that some breeders did not apply to have their herds recorded as they knew of rejections in their district.

The total number of cows submitted during the year was 1,321; of these, 680 passed the required production standard, 384 failed and 257 were withdrawn. The particulars are given by breed in Table 2.

TABLE 1.

DETAILS OF HERDS RECORDED, 1947–48 TO 1949–50.

Breed.	1947–48.	1948–49.	1949–50. Under Old Rules only.	1949–50. Under Old and New Rules.	1949–50. Under New Rules only.	1949–50. Total.
A.I.S. ..	56	66	32	36	6	74
Ayrshire ..	3	8	2	5	1	8
Friesian ..	0	1	0	1	1	2
Guernsey ..	5	10	4	7	2	13
Jersey ..	60	64	24	36	10	70
Dairy Shorthorn ..	0	0	0	0	1	1
Totals ..	124	149	62	85	21	168

TABLE 2.

NUMBERS AND PERCENTAGES OF COWS COMPLETING LACTATIONS, 1948–49 AND 1949–50.

Breed.		Total. 1948-49.	Total. 1949-50.	Passed. 1948-49.	Passed. 1949-50.	Failed. 1948-49.	Failed. 1949-50.	Withdrawn. 1948-49.	Withdrawn. 1949-50.
A.I.S.	No.	660	611	314	278	140	165	206	168
	%	..	..	47·6	45·5	21·2	27·0	31·2	27·5
Ayrshire ..	No.	43	79	15	40	12	31	16	8
	%	..	..	34·9	50·6	27·9	39·2	37·2	10·1
Friesian ..	No.	7	8	3	2	0	4	4	2
	%	..	..	42·8	25·0	0	50·0	57·2	25·0
Guernsey ..	No.	72	101	42	66	12	23	18	12
	%	..	..	58·3	65·3	16·7	22·8	25·0	11·9
Jersey	No.	645	519	385	294	141	158	119	67
	%	..	..	59·7	56·6	21·9	30·4	18·4	12·9
Dairy Shorthorn	No.	0	3	0	0	0	3	0	0
	%	..	..	..	..	..	100·0	..	..
Total ..	No.	1,427	1,321	759	680	305	384	363	257
	%	..	..	53·2	51·5	21·4	29·1	25·4	19·4

TABLE 3.

Number of Cows Passing, Failing and Withdrawn Each Year since 1942–43.

Year.	Passed.	Failed.	Withdrawn.	Total.
1942–43	249	60	..	..
1943–44	199	74	..	..
1944–45	278	112	60	450
1945–46	363	113	92	568
1946–47	366	80	262	708
1947–48	421	200	263	884
1948–49	759	305	363	1,427
1949–50	680	384	257	1,321

The numbers of cows recorded in each year since 1942-43 are shown in Table 3.

Production Averages.

Various production averages are given in Tables 4, 5 and 6 (pages 12-13).

Meritorious Yields.

Many high producing cows have been recorded during the period over which pure-bred herd recording has been operating in the State. A list of cows who have produced at least 820 lb. butterfat (equivalent to at least 1,000 lb. commercial butter) in a single lactation is given as Table 7 (page 14).

It will be noted that the list includes 16 A.I.S. cows, one Jersey, and one Friesian. ''Alfa Vale Model 4th'' produced more than 820 lb. butterfat on two occasions. The highest production is credited to ''Charmer 2nd of City View,'' which produced 949 lb. butterfat in 1920; the next highest yield was given by the Jersey cow ''Gem May'' in 1946.

The latest cow to qualify for inclusion in the list is ''Fairvale Laurel 2nd,'' who in a lactation still proceeding at the time of writing produced 853 lb. butterfat in the first 273 days. The lactation is being extended to 365 days.

Information on the individual production records according to age groups of the different breeds of dairy cattle is of interest and is presented in Tables 8 and 9 (pages 15-16) for lactation periods of 273 days and 365 days, respectively.

Outstanding performances during the 1949-50 period included the following:—

The mature cow ''Fairvale Laurel 2nd,'' owned by Mr. W. Henschell, ''Yarranvale,'' Yarranlea, gave the most creditable performance during the year. Her production in 273 days was 23,094 lb. milk and 853 lb. butterfat. The average test was 3·7 per cent. butterfat. As previously mentioned, this puts the cow into the select band of ''thousand pound'' cows. Recorded previously as a Junior 3, she produced 590 lb. butterfat. This cow won the ground milking competition at the Brisbane Exhibition in 1946.

''Trevor Hill Bonnie,'' owned by the same breeder, produced 18,685 lb. milk and 775 lb. butterfat in 273 days. The average test was 4·1 per cent. It will be recalled that this cow won the ground milking competition at the 1949 Brisbane Exhibition with a ground

record of 6·9 lb. butterfat in 48 hours. Her previous yields, which stamp her as a consistent producer, were:—

Junior 2	..	11,959 lb. milk; 552 lb. butterfat.
Junior 3	..	11,355 lb. milk; 497 lb. butterfat.
Junior 4	..	12,686 lb. milk; 547 lb. butterfat.

"Dorravista Floss," owned by Mr. H. A. Turner, Tarzali, produced as a mature cow 15,315 lb. milk and 752 lb. butterfat. The average fat content of the milk was 4·9 per cent.

"Valera Roseleaf 16th," owned by Messrs. Sullivan Brothers, "Valera," Pittsworth, produced 16,745 lb. milk and 716 lb. butterfat as a mature cow in 273 days. The average butterfat test was 4·2 per cent. This cow is by "Alfa Vale Pride 2nd," who has over 30 daughters recorded; particulars of the performances of these cows are given on page 50. Previous yields recorded for "Valera Roseleaf 16th" were:—

Junior 2	..	8,270 lb. milk; 325 lb. butterfat.
Junior 3	..	14,527 lb. milk; 586 lb. butterfat.

She was reserve champion in the ground milking competition at the Brisbane Exhibition in 1949.

"Emby Vale Velvet," owned by Madge Brothers, Southbrook, produced 15,464 lb. milk and 631 lb. butterfat as a Junior 3 in 273 days. The fat test averaged 4·0 per cent.

"Navillus Showgirl 4th," owned by Mr. C. O'Sullivan, Greenmount, produced 19,322 lb. milk and 709 lb. butterfat as a mature cow. The average fat percentage was 3·6.

"Alfa Vale Model 29th," owned by Mr. W. H. Thompson, Nanango, produced 17,635 lb. milk of 4·8 per cent. test, yielding 847 lb. butterfat, in 349 days as a Junior 3. This yield places the cow in the "thousand pound" group.

Table 10 shows the class leaders for 1949-50 in each age group for butterfat produced in 273 days.

Records of all Individual Cows.

Records of cows which completed lactations during the year ended 30th June, 1950, are given in Table 11 (pages 18-49).

An examination of the production records listed under each owner's name reveals some very interesting information, particularly regarding the production of daughters of various sires. Space does not permit the mentioning of all such results, but the results in two herds are very striking.

In the A.I.S. herd owned by Mr. M. C. Lester, Glengallan, Warwick, it is noted that the sire "Tabbagong Victory" had ten two-year-old daughters who completed lactations during the year. Altogether, up to the 30th June, 1950, eleven daughters of this bull had completed fourteen recorded lactations as two-year-olds, with an average production of 291 lb. butterfat.

In the Jersey herd owned by Mr. F. Porter, "Westwood," Cambroon, where the greatest number of daughters by the one sire was recorded, "Devon Park Madeira's Victorious" had fifteen daughters recorded during the year. Up to date, twenty-one daughters of this sire recorded as two-year-olds have given an average production of 319 lb. butterfat.

It will be interesting to watch the production records of the daughters of these two sires, as well as those of other sires from year to year, to see if they live up to the expectations aroused by their initial performances.

A Preliminary Survey of Sires.

In order to provide some information about sires, an assessment of their production transmitting qualities has been commenced. In this issue information is given concerning all bulls which have a minimum of ten daughters recorded since 1942. Table 12 (pages 50-52) shows the average production, according to age groups, of the recorded daughters and the average of all daughters. As satisfactory age correction factors for the State have not been arrived at, the figures shown are the averages of all actual productions without any age allowance.

Where a daughter has more than one record in any particular age group, the average of these records is taken. Similarly, in computing the average production for the total number of daughters, where a daughter has been recorded more than once, the average of all her lactations is taken.

An endeavour was made to obtain the total number of daughters sired by each bull, but it was impossible to obtain this information from the Herd Book Societies.

The results for various bulls will be amended from year to year as more records from their progeny become available.

It is realised that many of the listed bulls have been dead for some time, but it is felt that, as some farmers may be line breeding to them, it is essential to publish information regarding them.

Use of Records.

In connection with the information supplied it is necessary to consider in conjunction therewith a number of points, viz.:—

1. *The number of daughters recorded.*—The larger the number the greater the possibility of the results being representative of the whole of the daughters of a bull.

2. *The number of lactations.*—Cows should preferably be recorded continuously in order to demonstrate their ability to continue producing at a high level over a number of years. Where a large number of lactations are shown it indicates that many of the daughters were recorded more than once and this should assist in stabilising the average production.

3. *Conditions under which the records were made.*—In this regard notice should be taken of the following points:—

(*a*) The percentage of the herd production recorded.

(*b*) Feeding—that is, whether recorded cows were fed under normal herd conditions or specially fed under artificial conditions to produce high yields.

Basis for Selection of a Sire.

When buying a bull it is essential to consider the following factors :—

(1) Production records of his daughters, if available.

(2) Production records of the daughters of the sire of the bull being purchased.

(3) Production records of his dam and of her daughters and/or sisters.

(4) The conditions under which the productions were recorded. It is advisable to visit the farm of the breeder and see whether the conditions on that farm approximate conditions on the farm for which the bull is intended. The bull's sire, dam, sisters and half sisters should be inspected, and above all, if he is old enough, his progeny should be examined. Honest breeders will be only too pleased to show the prospective buyer around the premises and also the factory returns from the herd. These returns provide a guide as to the productive ability of the herd as a whole.

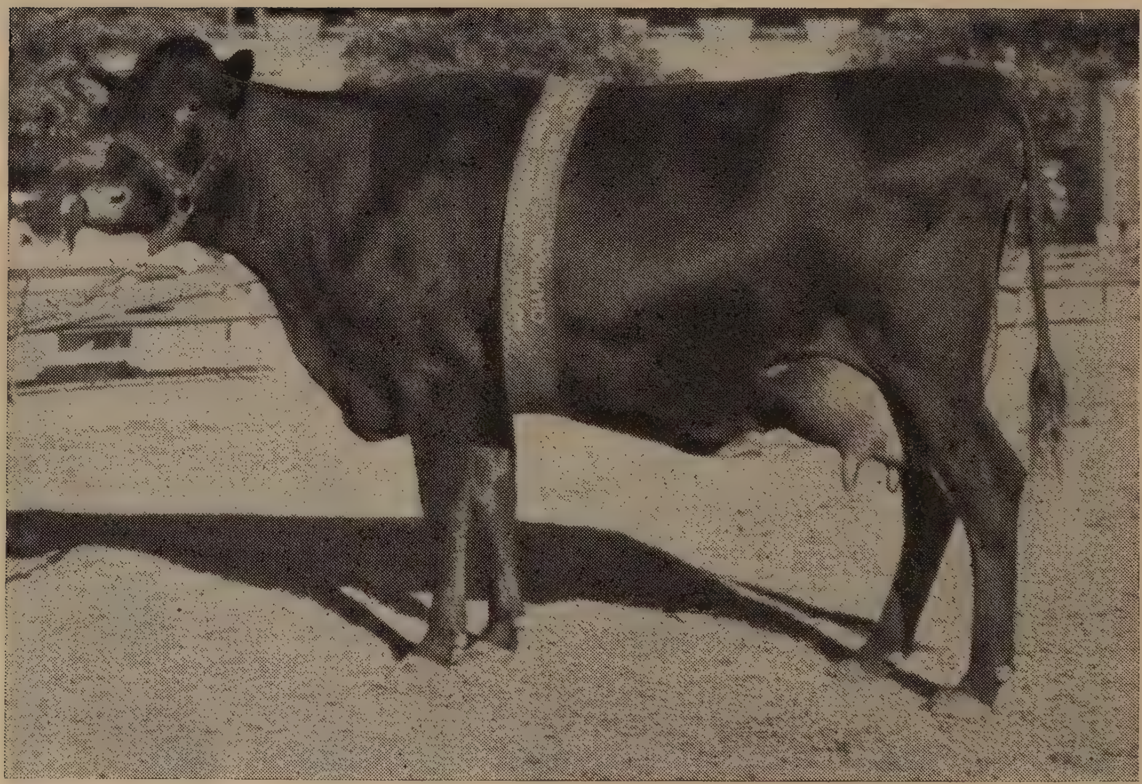

Plate 1.

"Fairvale Laurel 2nd" (owned by Mr. W. Henschell, "Yarranvale," Yarranlea), was the highest producing A.I.S. cow for 1949-50. Her production was 23,094 lb. milk with an average test of 3.7 per cent., and 853 lb. butterfat. (Photograph by E. H. Mears, Kumbia.)

Plate 2.

"Trevor Hill Bonnie" (owned by Mr. W. Henschell, "Yarranvale," Yarranlea), was the second highest producer during 1949-50, with the production of 18,685 lb. milk at an average test of 4.1 per cent., and 775 lb. butterfat. (Photograph by "The Primary Producer.")

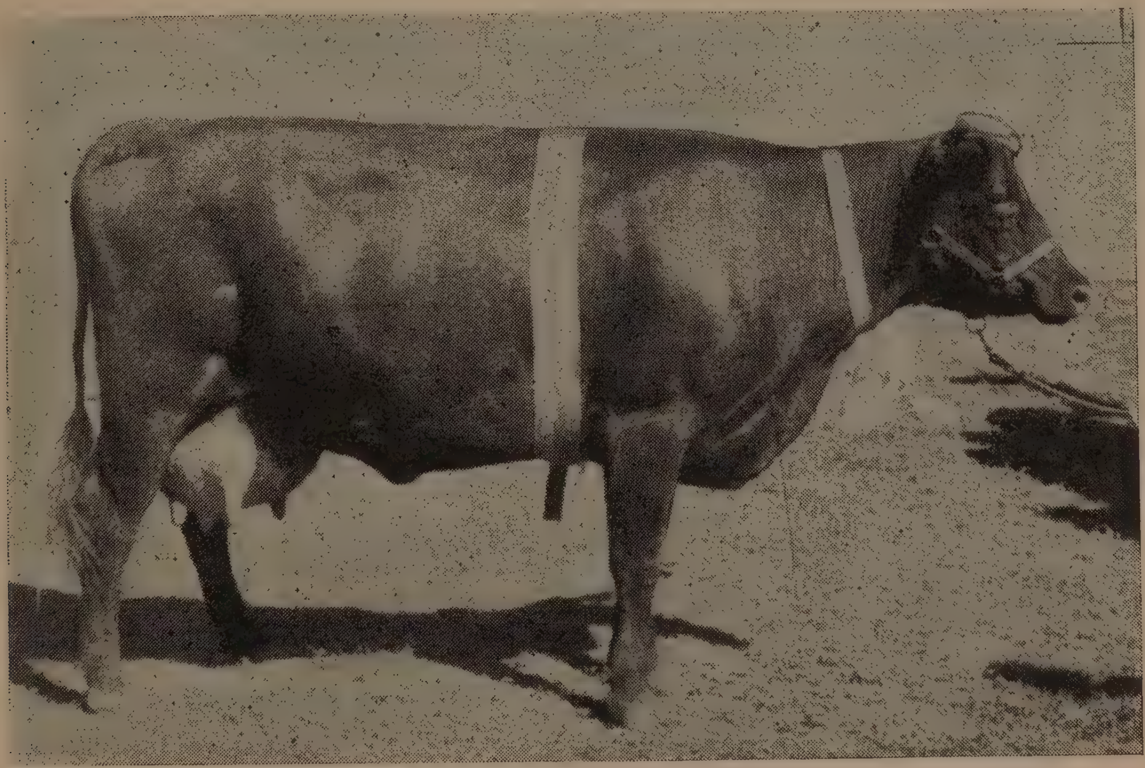

Plate 3.

"Dorravista Floss" (owned by Mr. H. A. Turner, Tarzali, North Queensland), as a mature cow produced 15,315 lb. milk and 752 lb. butterfat. The average fat content of the milk was 4.9 per cent. This production is the highest ever recorded in North Queensland.

Plate 4.

"Valera Roseleaf 16th" (owned by Messrs. Sullivan Bros., "Valera," Pittsworth), produced 16,745 lb. milk of an average test of 4.2 per cent., and 716 lb. butterfat. (Photograph by "Queensland Country Life.")

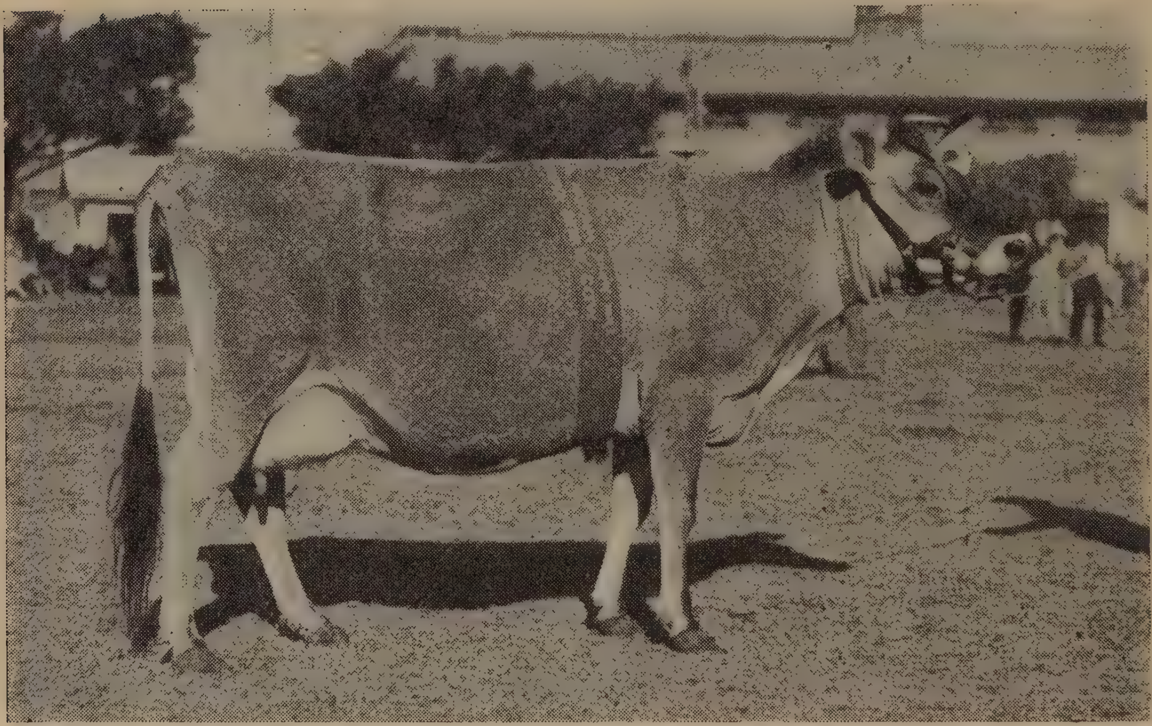

Plate 5.

"Gem May" (owned by Mr. W. Bishop, "Gem Jersey Stud," Kenmore), in 1946 produced 15,065 lb. milk with an average fat content of 6.1 per cent., and 946 lb. butterfat, in 365 days. This production is the highest ever produced by a Jersey cow and the second highest for any breed ever recorded in Queensland. (Photograph by E. H. Mears, Kumbia.)

Plate 6.

"Westbrook Tulip 134th" (owned by the Farm Home for Boys, Westbrook), was the highest producing Jersey cow in 1949-50, with 10,166 lb. milk of a 5.3 per cent. test, and 545 lb. butterfat. (Photograph by "Queensland Country Life.")

Plate 7.

"Elersley Jonquil" (owned by Stimpsons Ltd., Loganlea), was the highest producing Ayrshire cow in 1949-50. Her production was 10,745 lb. milk and 448 lb. butterfat. The average test of the milk was 4.1 per cent.

Plate 8.

"Laureldale Dot" (owned by Mr. W. A. K. Cooke, "Laureldale," Maleny), gave the greatest yield for Guernsey cows in 1949-50, with a production of 9,385 lb. milk, of 4.8 per cent. test and 459 lb. butterfat.

Plate 9.

"St. Athans Priebe Annette 2nd" (owned by Mr. C. H. Naumann, Yarraman), was the highest producing Friesian cow in 1949-50. She produced 15,984 lb. milk, with an average fat content of 3.16 per cent., and 506 lb. butterfat.

Plate 10.

"Alfa Vale Pride 2nd" and three of his daughters. Thirty-two daughters of this bull have been recorded, with an average butterfat yield of 330 lb. Alfa Vale Pride 2nd is owned by Messrs. Sullivan Bros., "Valera," Pittsworth. (Photograph by E. H. Mears, Kumbia.)

Plate 11.

"Tabbagong Victory" (owned by Mr. M. C. Lester, St. Andrews A.I.S. Stud, Warwick). During the year ten of this bull's daughters were recorded. In all, eleven daughters have been recorded as two-year-olds and have an average production of 291 lb. butterfat. (Photograph by E. H. Mears, Kumbia.)

TABLE 4.

AVERAGE PRODUCTION OF TESTED COWS, 1946–47 TO 1949–50.

Year.	No. of Cows.	Average Production.		
		Milk.	Test.	Butterfat.
		Lb.	%	Lb.
1946–47	446	6,580	4·95	326
1947–48	621	6,981	4·67	326
1948–49	1,064	6,783	4·76	323
1949–50	1,064	6,608	4·69	310

TABLE 5.

BREED PRODUCTION AVERAGES FOR REGISTERED HERD BOOK STOCK WHICH COMPLETED LACTATION RECORDS OF 273 DAYS DURING THE YEAR ENDING 30TH JUNE, 1950.

Breed.	—	J.2.	S.2.	J.3.	S.3.	J.4.	S.4.	Mature.	All Ages.
A.I.S. ..	No. of Cows..	129	93	53	38	26	19	85	443
	Milk (lb.) ..	6,359	6,617	7,520	7,499	8,458	7,189	9,972	7,502
	Butterfat (lb.)	253	286	310	307	337	285	402	306
	Test (%) ..	3·98	4·31	4·11	4·09	3·97	3·97	4·03	4·08
Ayrshire ..	No. of Cows..	23	7	10	5	4	2	20	71
	Milk (lb.) ..	5,789	5,120	6,964	6,041	8,334	6,930	8,828	6,938
	Butterfat (lb.)	236	275	278	259	326	270	329	279
	Test (%) ..	4·07	5·36	3·99	4·28	3·9	3·88	3·72	4·02
Friesian ..	No. of Cows..	1	..	..	..	..	1	4	6
	Milk (lb.) ..	6,556	..	..	..	..	9,089	10,474	9,590
	Butterfat (lb.)	233	..	..	..	..	318	351	326
	Test (%) ..	3·55	..	..	..	..	3·49	3·35	3·39
Guernsey..	No. of Cows..	30	6	12	9	3	4	25	89
	Milk (lb.) ..	5,384	6,627	6,075	6,424	6,680	7,310	7,142	6,290
	Butterfat (lb.)	260	301	312	331	304	376	357	311
	Test (%) ..	4,82	4·54	5·13	5·14	4·55	5·14	4·99	4·94
Jersey ..	No. of Cows..	127	79	62	35	28	25	96	452
	Milk (lb.) ..	4,832	5,553	5,637	6,178	6,221	6,016	6,687	5,718
	Butterfat (lb.)	291	289	364	300	328	316	360	320
	Test (%) ..	6·02	5·2	6·45	4·85	5·27	5·26	5·38	5·59
Dairy Shorthorn	No. of Cows..	..	1	1	..	..	1	..	3
	Milk (lb.) ..	..	3,903	5,394	..	..	4,020	..	4,439
	Butterfat (lb.)	..	156	195	..	..	138	..	163
	Test (%) ..	..	3·99	3·61	..	..	3·4	..	3·67

All ages and all breeds :—No. of cows, 1,064 ; milk, 6,608 lb. ; butterfat, 310 lb ; test, 4·69%.

TABLE 6.

BREED PRODUCTION AVERAGE FOR REGISTERED HERD BOOK STOCK WHICH COMPLETED LACTATION RECORDS OF 273 DAYS BETWEEN 1930 AND 1950.

Breed.	—	J.2.	S.2.	J.3.	S.3.	J.4.	S.4.	Mature.	All Ages.
A.I.S. ..	No. of lactations ..	1,287	763	484	366	273	248	1,105	4,526
	Average Milk (lb.) ..	6,754	7,181	7,701	8,456	8,341	8,806	9,685	7,987
	Average Butterfat (lb.)	270	292	313	333	337	351	389	321
	Average Test (%) ..	4·0	4·06	4·06	3·94	4·04	3·98	4·02	4·02
Ayrshire ..	Number of lactations..	94	37	39	49	18	19	110	366
	Average Milk (lb.) ..	6,012	6,146	7,213	7,505	7,145	8,543	8,171	7,189
	Average Butterfat (lb.)	253	259	286	297	290	347	326	288
	Average Test (%) ..	4·2	4·21	3·96	3·96	4·06	4·06	3·99	4·0
Friesian ..	Number of lactations..	40	20	15	6	4	9	29	123
	Average Milk (lb.) ..	7,651	9,000	8,338	9,055	10,238	9,416	11,990	9,339
	Average Butterfat (lb.)	293	328	303	330	345	359	426	340
	Average Test (%) ..	3·83	3·64	3·63	3·64	3·37	3·81	3·55	3·64
Guernsey..	Number of lactations..	79	52	42	26	13	12	66	290
	Average Milk (lb.) ..	5,515	6,150	6,486	6,350	7,184	7,190	7,737	7,494
	Average Butterfat (lb.)	271	292	326	313	337	364	387	319
	Average Test (%) ..	4·91	4·75	5·02	4·93	4·69	5·06	5·00	4·25
Jersey ..	Number of lactations..	1,748	611	500	390	295	248	1,055	4,847
	Average Milk (lb.) ..	4,864	5,527	5,892	6,356	6,522	6,771	6,977	5,832
	Average Butterfat (lb.)	268	295	322	337	348	361	369	314
	Average Test (%) ..	5·51	5·34	5·46	5·30	5·34	5·33	5·29	5·38
Red Poll	Number of lactations	3	3	..	..	..	..	6	12
	Average Milk (lb.) ..	5,293	6,122	..	..	..	..	7,373	6,540
	Average Butterfat (lb.)	212	244	..	..	..	..	277	252
	Average Test (%) ..	3·99	4·0	..	..	..	..	3·75	3·86
Dairy	Number of lactations..	..	1	1	..	..	1	..	3
Shorthorn	Average Milk (lb.) ..	..	3,903	5,394	..	..	4,020	..	4,439
	Average Butterfat (lb.)	..	156	195	..	..	138	..	163
	Average Test (%) ..	..	3·99	3·61	..	..	3·4	..	3·67

TABLE 7.

COWS WHICH HAVE PRODUCED BUTTERFAT EQUIVALENT TO 1,000 LB. COMMERCIAL BUTTER IN ONE LACTATION.

Name of Cow.	Owner.	Breed.	Date of Calving.	Age.		Days in Lactation.	Milk.	Test.	Butterfat.	Estimated Commercial Butter.
				Y.	M.		Lb.	%	Lb.	Lb.
Charmer 2nd of City View ..	M. Lawrence ..	A.I.S. ..	1920	6	3	365	21,304	4·5	949	1,167
Gem May	W. Bishop	Jersey ..	11–10–46	9	9	365	15,065	6·1	924	1,127
Alfa Vale Model 4th ..	W. H. Thompson ..	A.I.S. ..	3–7–41	9	0	365	19,151	4·8	922	1,124
Alfa Vale Model 2nd ..	W. H. Thompson ..	A.I.S. ..	1–6–40	10	9	328	18,530	4·9	904	1,102
Evelyn of Sunnyview ..	J. Phillips	A.I.S. ..	18–8–33	6	11	273	22,575	4·0	904	1,102
Alfa Vale Nellie 4th	W. H. Thompson ..	A.I.S. ..	12–4–39	6	4	365	23,889	3·7	890	1,085
Alfa Vale Pansy	W. H. Thompson ..	A.I.S. ..	2–8–42	4	11	365	19,824	4·5	887	1,082
Alfa Vale Gem 4th	W. H. Thompson ..	A.I.S. ..	26–7–37	5	0	365	21,325	4·1	884	1,078
Alfa Vale Laura	W. H. Thompson ..	A.I.S. ..	4–7–39	5	8	365	23,158	3·7	858	1,046
Fairvale Laurel 2nd	W. Henschell ..	A.I.S. ..	14–9–49	6	3	273	23,094	3·7	853	1,040
Alfa Vale Model 4th ..	W. H. Thompson ..	A.I.S. ..	3–4–40	7	10	365	19,106	4·4	847	1,033
Alfa Vale Model 29th ..	W. H. Thompson ..	A.I.S. ..	8–5–48	3	5	349	17,635	4·8	847	1,033
Valera Sheila	Sullivan Bros. ..	A.I.S. ..	13–3–38	7	4	365	16,239	5·2	847	1,033
Penrhos Pansy	A. Sandilands ..	A.I.S. ..	25–5–35	7	3	273	17,603	4·7	844	1,029
Alfa Vale Model 3rd ..	W. H. Thompson ..	A.I.S. ..	12–8–36	6	1	365	18,734	4·4	835	1,018
College Princess Pontiac ..	Hickey and Sons ..	Friesian	3–5–32	7	10	365	24,027	3·4	830	1,012
Kilburnie Ethel 3rd	Macfarlane Bros. ..	A.I.S. ..	5–7–33	7	11	365	18,108	4·6	829	1,011
Blossom of Penrhos	A. Sandilands ..	A.I.S. ..	10–8–31	6	5	365	18,933	4·3	824	1,005
Fairvale Laurel 2nd	W. Henschell ..	A.I.S. ..	(853 lb. Butterfat in 273 days in Lactation still proceeding)							

TABLE 8.

EXISTING PRODUCTION RECORDS FOR 273 DAYS FOR VARIOUS AGE GROUPS IN EACH BREED.

Age.	Cow.	Owner.	Year of Test.	Milk.	Test.	Butterfat.
		A.I.S.		Lb.	%	Lb.
J.2	Diana 17th of Kelston	A. Frank, Boonah	1930	13,604	4·20	572
S.2	Alfa Vale Model 16th	W. H. Thompson, Nanango	1942	12,783	5·00	640
J.3	Alfa Vale Model 29th	W. H. Thompson, Nanango	1949	14,516	4·07	691
S.3	SunnyviewBeauty 6th	J. Phillips, Wondai	1948	16,577	4·42	733
J.4	Alfa Vale Gentle 2nd	W. H. Thompson, Nanango	1936	15,186	4·57	695
S.4	Kyabram Mab	C. W. Black, Kumbia	1940	16,963	4·32	733
Mature	Sunnyview Evelyn	J. Phillips, Wondai	1933	22,575	4·00	904
		JERSEY.				
J.2	Inverlaw Phyllis	R. J. Crawford, Kingaroy	1940	9,756	5·57	544
S.2	Hamilton White Rose	J. Wilton, Killarney	1934	8,060	6·52	526
J.3	Lyndhurst Mollie	J. B. Keys, Gowrie	1931	11,828	4·83	571
S.3	Oxford Jezebel	E. Burton and Sons, Wanora	1941	10,950	5·88	644
J.4	Oxford Buttercup 4th	E. Burton and Sons, Wanora	1922	11,331	5·93	672
S.4	Trecarne Dairymaid	T. A. Petherick, Lockyer	1940	9,584	7·31	701
Mature	Brookland Cunning Drop	W. S. Conochie, Sherwood	1948	12,800	5·87	752
		GUERNSEY.				
J.2	Linwood Feather	A. S. Cooke, Maleny	1944	9,183	4·42	406
S.2	Linwood Holly	A. S. Cooke, Maleny	1944	9,816	4·38	430
J.3	Bangalow Vale Vanity Fair 3rd	W. A. K. Cooke, Maleny	1948	9,664	4·81	465
S.3	Linwood Sister	A. S. Cooke, Maleny	1944	8,992	5·02	452
J.4	Laureldale Vera	W. A. K. Cooke, Maleny	1945	9,599	4·96	476
S.4	Laureldale Vida	W. A. K. Cooke, Maleny	1946	10,313	4·82	498
Mature	Laureldale Vida	W. A. K. Cooke, Maleny	1948	12,473	4·51	563
		AYRSHIRE.				
J.2	Myola Gem 2nd	J. R. and R. M. Anderson	1937	12,578	3·74	472
S.2	Myola Jollity	J. R. and R. M. Anderson	1935	8,712	4·54	396
J.3	Myola Lady Tina	J. R. and R. M. Anderson	1937	8,126	4·77	388
S.3	Myola Jollity	J. R. and R. M. Anderson	1936	10,995	4·34	477
J.4	Fairview Pride	J. R. and R. M. Anderson	1930	8,028	4·33	348
S.4	Myola Lady Jean	J. R. and R. M. Anderson	1938	14,377	4·76	685
Mature	Fairview Vesta	J. R. and R. M. Anderson	1938	10,856	4·87	529
		FRIESIANS.				
J.2	Ryfield Dairymaid 8th	P. Falt, Cushine	1937	8,139	4·54	370
S.2	St. Athan's Bee	W. Newman, Wyreema	1930	14,143	3·12	442
J.3	St. Athan's Piebe Molly	F. C. Noller, Kumbia	1936	11,813	3·69	436
S.3	Brigalow Gem 2nd	A. O. Stumer, Boonah	1934	9,801	3·76	369
J.4	Tent Hill Princess	W. H. Grams, Gatton	1938	11,366	3·62	412
S.4	Stonybrae Belle	Hickey and Sons Pty. Ltd., Wilston	1930	11,156	3·69	412
Mature	College Princess Pontiac	Hickey and Sons Pty. Ltd., Wilston	1932	19,315	3·40	657

TABLE 9.

Existing Production Records for 365 Days for Various Age Groups in each Breed.

Age.	Cow.	Owner.	Year of Test.	Milk.	Test.	Butterfat.
				Lb.	%	Lb.
		A.I.S.				
J.2	Diana 17th of Kelston	A. Frank, Boonah	1930	17,430	4·14	721
S.2	Alfa Vale Pansy	W. H. Thompson, Nanango	1940	16,237	4·59	746
J.3	Greyleigh Gem 139th	W. H. Thompson, Nanango	1943	16,825	4·46	751
S.3	Alfa Vale Gem 7th	W. H. Thompson, Nanango	1940	14,649	4·92	721
J.4	Alfa Vale Gentle 2nd	W. H. Thompson, Nanango	1936	17,369	4·71	818
S.4	Alfa Vale Pansy	W. H. Thompson, Nanango	1942	19,824	4·47	887
Mature	Charmer 2nd of City View	M. Lawrence, Bundamba	1920	21,304	4·45	949
		JERSEY.				
J.2	Inverlaw Phyllis	R. J. Crawford, Kingaroy	1940	12,472	5·85	730
S.2	Hamilton White Rose	J. Wilton, Killarney	1934	9,812	6·66	654
J.3	Lyndhurst Marella	J. B. Keys, Gowrie	1932	11,225	5·44	611
S.3	Lavender of Calton	E. Burton and Sons, Wanora	1933	15,249	5·07	773
J.4	Does not exceed the record for 273 days					
S.4	Does not exceed the record for 273 days					
Mature	Gem May	W. Bishop, Kenmore	1947	15,065	6·13	924
		GUERNSEY.				
J.3	Laureldale Pamela	W. A. K. Cooke, Maleny	1948	11,698	4·86	569
		AYRSHIRE.				
		No records for 365 days.				
		FRIESIAN.				
S.2	St. Athan's Bee	W. Newman, Wyreema	1930	18,008	3·13	564
Mature	College Princess Pontiac	Hickey and Sons Pty. Ltd., Wilston	1932	24,027	3·45	830

TABLE 10.

CLASS LEADERS IN EACH AGE GROUP FOR BUTTERFAT PRODUCED IN 273 DAYS

Age Class.	Cow.	Milk. Lb.	Test. %	Butterfat. Lb.
	A.I.S.			
Mature ..	Fairvale Laurel 2nd	23,094	3·7	853
S.4 ..	Bunya View Scarlet 2nd	10,720	4·6	495
J.4 ..	Navillus Show Girl 5th	15,034	3·6	552
S.3 ..	Glen Idol Daphne 25th	11,607	4·3	511
J.3 ..	Emby Vale Velvet	15,464	4·0	631
S.2 ..	Valera Sally 17th	10,613	4·2	451
S.2 ..	Blacklands Foremost 44th ..	11,310	4·0	451
J.2 ..	Trevor Hill Rosalyn	9,357	4·8	450
	JERSEY.			
Mature ..	Westbrook Tulip 134th	10,166	5·3	545
S.4 ..	Lermont Model 2nd	6,599	6·3	419
J.4 ..	Strathdean Victors Dolly	8,308	4·4	451
S.3 ..	Manneum Cosmos 2nd	8,135	5·8	474
J.3 ..	Glenrandle Lulu	7,861	5·6	444
S.2 ..	Westwood Majesty	6,464	6·8	442
J.2 ..	Kathleigh Silversheen	7,612	5·7	438
	AYRSHIRE.			
Mature ..	Elersley Jonquil	10,745	4·1	448
S.4 ..	No cow exceeded standard	—	—	—
J.4 ..	Crescent Farm Joyous	10,848	3·8	411
S.3 ..	Leafmore Bonnie Queen	6,872	4·3	296
J.3 ..	Elersley Gay Girl 2nd	8,303	4·1	340
S.2 ..	Crescent Farm Monnie	9,683	4·3	415
J.2 ..	Crescent Farm Annabelle	9,964	3·6	359
	GUERNSEY.			
Mature ..	Laureldale Dot	9,385	4·8	459
S.4 ..	Oakwood Winkle	6,830	5·8	394
J.4 ..	Oakwood Fay	6,829	4·6	317
S.3 ..	Fernhill Lovely	7,648	5·4	417
J.3 ..	Laureldale Buttermaid	6,820	5·6	387
S.2 ..	Springvale Fanny	7,748	4·7	354
J.2 ..	Willowbrae Daffodil	7,157	4·7	336
	FRIESIAN.			
Mature ..	St. Athans Priebe Annette 2nd ..	15,984	3·16	506
S.4 ..	Rockview Beauty	9,089	3·4	318
J.2 ..	Yarrabine Dell	6,556	3·5	233

TABLE 11.

Records of Cows Completing Lactation Records During the Year Ended 30th June, 1950.

Explanation of Table.

Owners are listed alphabetically.

Cows completing records under the old scheme are marked †. Under this scheme, the records of cows which failed to reach the required standard are not shown.

Cows milked three times a day during some period of their lactations are indicated by an asterisk (*).

In brackets after the owner's name are shown the breed and the number of cows whose production records are given.

The butterfat production required for entry to the Advanced Register varies according to the age, and is as follows:—

Junior 2 year old (under 2½ years at calving)	230 lb. butterfat
Senior 2 year old (between 2½ and 3 years at calving)	250 lb. butterfat
Junior 3 year old (between 3 and 3½ years at calving)	270 lb. butterfat
Senior 3 year old (between 3½ and 4 years at calving)	290 lb. butterfat
Junior 4 year old (between 4 and 4½ years at calving)	310 lb. butterfat
Senior 4 year old (between 4½ and 5 years at calving)	330 lb. butterfat
Mature (5 years or over at calving)	350 lb. butterfat

Cow.	Sire.	Age.	Days Recorded.	Production. Milk.	Test.	Butterfat.
				Lb.	%	Lb.
AHERN, J., Conondale (Jersey, 16).						
†Brooklodge Joyful Girl	Trinity Mighty Prince	S.2	273	6,359	5·5	351
†Brooklodge Silicia 2nd	Trecarne Some Victor 4th	J.2	273	4,314	6·4	279
†Connemara Fancy Dress	Glenview Lochiel	S.2	273	4,182	6·8	286
Brooklodge Amethyst	Trinity Mighty Prince	S.4	273	7,627	4·7	364
Brooklodge Amethyst	Trinity Mighty Prince	S.4	305	8,293	4·8	402
Brooklodge Golden Gleam	Trecarne Some Victor 4th	S.2	273	5,719	5·2	299
Brooklodge Golden Gleam	Trecarne Some Victor 4th	S.2	305	6,254	5·2	330
Connemara Rosemary	Belgonia Flashlight	S.2	273	4,991	5·4	270
Connemara Rosemary	Belgonia Flashlight	S.2	305	5,251	5·4	287
Connemara Mistress Daphne	Belgonia Flashlight	S.2	273	5,039	5·1	261
Connemara Queen Beatrice	Belgonia Flashlight	S.2	273	4,437	5·0	225
Navua Designing Fillpail	Navua Designing Ruler	J.2	273	5,213	4·9	259
Connemara Welcome Dawn	Belgonia Flashlight	J.3	273	5,396	4·8	262
Connemara Cream Delight	Belgonia Flashlight	S.2	273	4,193	6·0	254
Brooklodge May Day	Trinity Mighty Prince	S.2	273	5,219	4·8	252
Brooklodge Fashion	Trecarne Some Victor 4th	S.2	273	4,670	5·1	238
Brooklodge Shine	Trinity Mighty Prince	S.2	273	4,407	5·3	235
Connemara Creamline	Belgonia Flashlight	J.2	273	4,643	5·3	249
Connemara Royal Violet	Belgonia Flashlight	J.2	273	3,766	5·4	207
BARKER, H. T. W., Oakey (Jersey, 4).						
†Parkview Merry Lass	Brookland Merry Cavalier	J.2	273	7,121	5·0	362
†Parkview Merry Princess	Brookland Merry Cavalier	J.2	273	6,314	4·2	266
†Parkview Merry Maiden	Brookland Merry Cavalier	S.2	273	5,215	4·9	259
†Parkview Velvet Princess	Westbrook Valour 7th	J.3	273	5,914	4·7	280

BARLOW, C. W., Boodua (Jersey, 6).						
†Kathleigh Soya 2nd	Oxford Fawn's Noble	J.3	273	5,344	5·7	306
†Kathleigh Silver 3rd	Oxford Fawn's Noble	S.3	273	6,967	5·7	399
†Kathleigh Fashionette 2nd	Oxford Fawn's Noble	S.3	273	6,173	5·7	354
Erceldene Regina	Gem Amber	J.2	273	6,504	5·2	341
Erceldene Elaine	Gem Amber	J.2	273	4,557	5·9	270
Kathleigh Patricia 5th	Marshlands Dreamer	J.2	210	2,361	5·6	134
BEATTIE, G. and V., Antigua (Jersey, 4).						
†Glenside Ellen	Navua Dreaming Brave	S.3	273	7,879	4·7	373
†Glenside Ivory	Oxford Dudley	J.3	273	4,801	5·6	270
†Boree Efforts Auriel	Trinity Daffodil's Effort	S.2	273	5,777	4·6	267
†Boree Efforts Auriel	Trinity Daffodil's Effort	S.2	305	6,508	4·6	303
†Boree Efforts Bountiful	Trinity Daffodil's Effort	S.2	273	6,918	3·7	259
BECKINGHAM, C., Everton Park (Jersey, 4).						
†Goldlands Daffodil	Calton Lotmyle	S.3	273	7,586	4·9	378
Locherbie Glorious	Oxford Tarzan	S.3	273	6,439	4·9	316
Glenrea Melody	Brampton Bandmaster	J.4	273	6,574	5·2	345
Locherbie Some Maiden	Trecarne Some Duke	J.2	273	4,392	5·3	236
BERGHOFER, H., Athol (A.I.S., 11).						
†Cleora Gleam	Rocklea Comet	J.2	273	7,508	3·8	287
†Cleora Winnie	Rocklea Comet	J.2	273	6,453	3·9	257
†Yarranvale Tot	Sunnyview Royal National	J.3	273	7,187	4·4	320
Cleora Charm	Rocklea Comet	J.2	273	6,069	3·6	220
Cleora Begonia	Rocklea Comet	J.2	240	5,391	3·5	192
Cleora Fairy	Rocklea Comet	J.2	240	4,644	3·6	170
Corunna Greta	Corunna Supreme	Mature	273	7,945	4·0	320
Cleora Briar Sweet	Rocklea Comet	J.2	273	6,389	4·0	265
Cleora Beauty	Rocklea Comet	J.2	273	6,941	3·3	234
Cleora Mafalda	Rocklea Comet	J.2	273	5,777	3·3	194
Cleora Amy	Rocklea Comet	J.2	240	4,749	3·3	157
BEST, H. A. and K. A., Nangwee (A.I.S., 1).						
Fairholme Melba	Camelot Campaigner	S.3	240	6,638	3·4	231

TABLE 11—*continued.*

RECORDS OF COWS COMPLETING LACTATION RECORDS DURING THE YEAR ENDED 30TH JUNE, 1950—*continued.*

Cow.	Sire.	Age.	Days Recorded.	Production. Milk.	Test.	Butterfat.
				Lb.	%	Lb.
BIRT, F. E., Sexton (A.I.S., 3).						
†Lynfield Matron 2nd	Bingleigh Jean's Monarch	J.2	273	6,366	3·7	237
†Lynfield Golden 2nd	Parkview Ransom	Mature	273	12,312	4·2	526
†Lynfield Pearl	Parkview Ransom	Mature	273	13,998	3·6	507
BISHOP, W., Kenmore (Jersey, 10).						
†Gem Cream Lily	Gem Loyal Highness	J.2	273	4,279	5·8	249
†Gem Dolores	Bulby Oxford Gamboge	S.4	273	8,490	4·5	386
†Gem Naomi	Trinity Cute Effort	J.3	273	6,730	4·5	309
†The Lodge Sadie	Gem Loyal Highness	S.2	273	7,462	4·4	331
†Gem Alexia	Bulby Maria's Keepsake	S.2	273	6,366	5·1	326
†Grasmere Sam's Tulip	Navua Victorious Samaritan	J.2	273	4,528	5·3	242
Gem Sultane	Bulby Maria's Keepsake	J.2	273	4,656	4·6	215
Gem Clarissa	Bulby Maria's Keepsake	J.2	273	5,907	5·2	312
Gem Carmen	Bulby Maria's Keepsake	J.2	273	4,779	5·0	243
Gem Cream Lily	Gem Loyal Highness	J.3	240	4,728	6·0	287
BLAIR, W. J., Cooroy (Jersey, 2).						
†Fauvic Playful	Glengariffe Caesar's Flavius	J.3	273	5,071	5·3	271
†Fauvic Marion	Fauvic Cornet	J.2	273	5,445	4·5	247
BORCHERT, Mrs. I. L. M., Kingaroy (Jersey, 14).						
†Trecarne Rosebud 8th	Trecarne Some Duke	S.4	273	5,931	6·1	365
†Glenmoore May Rose	Glenmoore May King	J.3	273	5,219	5·5	290
†Coolbar Ramona	Glenmoore Jean's Royal	J.3	273	6,649	4·9	329
†Trecarne Rosebud 9th	Trecarne Golden Lad	J.3	273	5,273	5·2	278
†Willow Bank Gold Wings	Inverlaw Observer	J.2	273	5,450	5·2	289
†Willow Bank Mottle Fortune	Brampton Daffodil's Peer	J.2	273	4,233	6·6	281
†Willow Bank Glee	Inverlaw Observer	J.2	273	4,603	5·0	233
†Coolbar Bloom	Rosel Governor	Mature	273	6,709	5·5	375

†Trecarne Dairy Lass 3rd	Brampton Daffodil's Peer	Mature	273	6,074	5·8	354
†Trecarne Some Eileen 3rd	Trecarne Ruler 2nd	S.3	273	6,519	4·6	303
†Trecarne Toddles 6th	Trecarne Ruler 2nd	S.2	273	4,329	6·0	262
Inverlaw Secret	Inverlaw Councillor	S.4	273	5,403	5·6	304
Willow Bank Volly's Pet	Inverlaw Observer	S.2	273	5,306	4·8	255
Willow Bank Coral	Brampton's Daffodil's Peer	J.2	273	4,732	5·0	239
	BRADFORD, A., Yangan (A.I.S., 4).					
Sunbridge Melba 4th	Sunbridge Umpire	Mature	150	3,888	4·2	164
Arolla Eva	Fairthorn Rainbow's Prince	S.3	210	4,518	3·6	166
Kanangra Susette	Ashstead Royal Major	S.4	210	5,592	3·4	193
Kanangra Melba	Ashstead Royal Major	S.4	150	3,606	3·4	123
	BROWNE, R.J., Yangan (Jersey, 19).					
†Nairfale Mayday	Nairfale Count's Paymaster	J.4	273	6,488	4·8	317
†Nairfale Gentle	Nairfale Golden Recorder	S.3	273	6,049	5·1	312
†Nairfale Gentle	Nairfale Golden Recorder	S.3	305	6,336	5·2	330
†Nairfale Coquette	Kelvinside Handsome Boy	J.3	273	5,934	5·1	304
†Nairfale Coquette	Kelvinside Handsome Boy	J.3	305	6,322	5·2	331
†Minidong Maid	Balwyn's Fancy Baron	S.2	273	7,087	5·2	370
†Minidong Maid	Balwyn's Fancy Baron	S.2	305	7,281	5·2	384
†Nairfale Comedy's Design	Kelvinside Handsome Boy	J.3	273	5,284	5·5	295
†Nairfale Comedy's Design	Kelvinside Handsome Boy	J.3	305	5,626	5·5	315
†Nairfale Coquette	Kelvinside Handsome Boy	J.3	365	7,068	5·2	374
†Nairfale Noble's Esteem	Nairfale Pride's Noble	J.2	273	5,714	5·8	333
†Nairfale Noble's Esteem	Nairfale Pride's Noble	J.2	305	6,173	5·9	365
†Nairfale Princess Beth	Nairfale Noble Count	Mature	273	8,593	5·3	460
†Nairfale Princess Beth	Nairfale Noble Count	Mature	305	9,460	5·3	504
Nairfale Princess Beth	Nairfale Noble Count	Mature	365	10,931	5·3	584
†Nairfale Comedy's Design	Kelvinside Handsome Boy	J.3	365	6,135	5·6	346
Nairfale Lady Laura	Nairfale Noble Count	Mature	273	8,535	5·4	468
Nairfale Mayday	Nairfale Count's Paymaster	Mature	273	6,008	5·0	300
Nairfale Brown Belle	Nairfale Count's Prominence	Mature	240	6,024	4·4	269
Nairfale Likeness	Nairfale Golden Recorder	S.4	273	9,975	4·6	462
Nairfale Likeness	Nairfale Golden Recorder	S.4	305	10,670	4·6	493
Nairfale Chenille	Kelvinside Handsome Boy	J.3	273	7,162	4·9	353
Nairfale Chenille	Kelvinside Handsome Boy	J.3	305	7,695	4·8	377
Hill 60 Golden Thread	Kelvinside Dream Boy	S.2	240	5,316	4·2	224
Hill 60 Mayday 2nd	Kelvinside Dream Boy	J.2	180	3,153	4·8	152
Nairfale Lena	Nairfale Golden Reality	Mature	273	7,500	5·0	377
Nairfale Trinket	Nairfale Count's Prominence	Mature	273	6,866	5·4	374
Nairfale Idol's Delight	Nairfale Golden Recorder	J.4	273	7,179	5·7	412
Nairfale Sapphire	Kelvinside Handsome Boy	J.3	273	5,659	4·3	245

TABLE 11—*continued.*

RECORDS OF COWS COMPLETING LACTATION RECORDS DURING THE YEAR ENDED 30TH JUNE, 1950—*continued.*

Cow.	Sire.	Age.	Days Recorded.	Production. Milk.	Test.	Butterfat.
				Lb.	%	Lb.
BROWNLIE, M.J., Nangwee (Ayrshire, 2).						
†Fairhill Anita	Myola Master 2nd	J.2	273	6,559	5·2	273
†Fairhill Lady Lana	Myola Master 2nd	J.2	273	5,546	4·6	257
BRUGGEMANN, H. L. and C. I., Kulpi (A.I.S., 7).						
†Boah Peak Ruby 6th	Fairvale Musketeer	J.4	273	8,940	4·8	429
†Kulpi Fussy	White Park Redman	J.4	273	7,924	4·2	333
†Boah Peak Model	Fairvale Musketeer	S.3	273	6,214	4·7	298
†Kulpi Dairymaid	White Park Redman	S.2	273	5,501	4·7	260
†Kulpi Jean 2nd	Fairvale Ethel's Monarch	J.2	273	6,566	3·9	259
†Kulpi Lovely	Fairvale Ethel's Monarch	S.2	273	7,020	3·8	270
†Kulpi Tulip 2nd	Fairvale Ethel's Monarch	J.2	273	6,646	3·6	245
BUGLER, J. J., Wowan (Jersey, 2).						
†Golden Hill June 2nd	Trinity Golden Chance	Mature	273	7,605	4·9	376
†Golden Hill Roselean	Golden Hill Joker	J.2	273	5,788	5·3	310
BYGRAVE P. J. L., Aspley (Jersey, 4).						
†Navua Egretta 3rd	Elm Hill Volxcnia Nobly Born (imp.)	J.3	273	5,764	5·6	327
†St. Joseph's Hazel 3rd	St. Joseph's High Design	S.3	273	6,309	4·6	292
Navua Boutilliere's Rosamond's Queen	Navua Elfa's Majestic	J.2	273	4,760	5·0	239
Navua Cecelia's Strike 2nd	Navua Sociable Designer	J.3	273	4,530	6·1	277
CAMPBELL, A. F., Killarney (A.I.S., 1).						
†Arolla Lady Sal	Parkview Highbrow	Mature	273	10,411	3·6	382
CARPENTER, C. M., Warra (Jersey, 2).						
†Strathdean Victor's Dolly	Oxford King's Victor	J.4	273	8,308	5·4	451
†Wyalla Tottie	Trecarne Supreme 3rd	J.3	273	6,604	5·4	363

	CARPENTER, J. W., Flagstone Creek (Jersey, 2).					
†Mayfair Joybell	Lermont Double Volunteer	J.4	273	6,171	5·9	365
†Mayfair Charm	Lermont Double Volunteer	J.2	273	5,662	5·8	329
	COCHRANE, H., Kin Kin (Jersey, 4).					
†Fauvic Recoil	Shepstone Gallant Lad	Mature	305	8,624	5·7	495
Fauvic Russet	Fauvic Collector	S.4	273	3,868	5·1	201
Fauvic Jollity	Fauvic Joker	J.4	273	4,832	5·6	271
Fauvic Cheg Sash	Austral Park Distinction	J.2	210	2,421	4·6	112
	COLVIN, J., Beechmont (Jersey, 8).					
Eumirvel Nonette	Eumirvel Beechmont Peer	Mature	273	5,961	5·5	332
Eumirvel Star Jewel	Avon Real Star (imp.)	S.2	273	5,690	5·1	294
Eumirvel Maisie	Eumirvel Beechmont Peer	Mature	273	5,569	6·0	339
Nairfale Mariette	Nairfale Pride's Noble	S.4	273	5,187	6·0	312
Ellerdale Cute's May	Richmond Cute Boy	S.4	273	4,220	6·2	263
Eumirvel Star Queen	Avon Real Star (imp.)	J.3	273	4,400	5·5	245
Eumirvel Star Belle	Avon Real Star (imp.)	S.2	273	5,907	5·9	351
Eumirvel Star Perfection	Avon Real Star (imp.)	J.2	273	4,758	5·1	247
	CONOCHIE, W. S., Sherwood (Jersey, 3).					
†Brooklands Merry Prudence	Bulby Maria's Keepsake	J.4	273	7,292	5·5	404
†Brooklands Cream Flake	Englorie Cunning Victor	Mature	273	7,303	5·8	430
†Brooklands Angel Cake	Bulby Maria's Keepsake	Mature	273	6,757	5·8	393
	CORNHILL, E. D. J., Dundas (Jersey, 7).					
Wattle Grove Lola 2nd	Morago Tauber	J.4	273	4,561	5·4	249
Wattle Grove Model 4th	Morago Tauber	S.3	273	4,889	4·8	239
Morago Rosebud	Brookland Merry Charmer	J.3	273	4,499	5·4	244
Gem Lady Bird	Gem Ralph	S.4	273	6,554	5·0	330
Hiddenvale Sapphire	Gem Bambi	S.2	273	4,220	5·3	225
Rosedene Beautiful	Lawnview Teddie	J.2	273	4,922	5·4	267
Rosedene Lady Olive	Lawnview Teddie	J.2	273	4,732	4·8	231
	CORNISH, A., Malanda (A.I.S., 1).					
†Margovale Tulip	Evansvale Duke	J 2	273	9,411	3·5	334

TABLE 11—*continued.*

RECORDS OF COWS COMPLETING LACTATION RECORDS DURING THE YEAR ENDED 30TH JUNE, 1950—*continued.*

Cow.	Sire.	Age.	Days Recorded.	Production. Milk.	Test.	Butterfat.
				Lb.	%	Lb.
	COOKE, J. M., Maleny (Guernsey, 11).					
†Brookland Leah	Brookland Landes Lad	J.2	273	5,440	5·3	292
†Brookland Winsome	Brookland Landes Lad	J.2	273	5,217	4·9	256
†Brookland Neridah	Brookland Landes Lad	J.2	273	4,494	5·2	234
†Adaville Olive	Laureldale Pluto	S.4	273	6,793	5·1	351
Adaville Sweetheart	Laureldale Pluto	Mature	273	7,910	4·7	376
Adaville Generous	Willowbrae Victory	S.3	273	5,683	5·1	295
Eleresley Belle	Sunny Valley Duke	J.2	273	6,548	4·5	296
Adaville Susan	Adaville Fuller	J.2	273	4,507	5·1	231
Laureldale Honest Lass	Linwood Favour	Mature	273	7,731	4·6	356
Adaville Gwenda	Laureldale Pluto	Mature	210	4,670	4·8	226
Adaville Merle	Willowbrae Victory	S.2	273	5,032	5·1	260
	COOKE, W. A. K., Maleny (Guernsey, 10).					
†Tattenbah Primrose	Laureldale Trump	Mature	273	8,536	4·8	410
†Laureldale Buttermaid 2nd	Minnamurra Air Lord	J.3	273	6,820	5·6	387
Ferndale Jewel	Ferndale Golden Sovereign	J.3	273	8,351	4·3	361
Laureldale Dot	Laureldale President	Mature	273	9,385	4·8	459
Laureldale Violet's Favourite	Bangalow Vale Guardsman	J.2	273	5,068	5·0	257
Ferndale Marymaid	Ferndale Golden Sovereign	J.2	273	5,289	4·4	233
Laureldale Vida 3rd	Bangalow Vale Guardsman	J.2	273	3,541	5·6	201
Laureldale Pamela	Minnamurra Topsy's Sequel 2nd	Mature	273	9,018	4·5	408
Fernhill Lovely	Laureldale Violet's Sequel	S.3	273	7,648	5·4	417
Breadalbane Diadem	Brookside Rose Laddie	S.3	273	7,498	5·1	386
	COONAN, J., Cambooya (A.I.S., 8).					
†Wonga Flower	Reservoir Yenda	S.2	273	7,992	4·6	372
†Wonga Cherry	Reservoir Yenda	S.2	273	8,740	4·2	368
†Wonga Molly	Reservoir Yenda	J.2	273	9,200	5·7	424
†Ennismore Florrie 2nd	Arolla Limerick	J.2	273	7,845	4·3	337
†White Park Pendant 27th	Karawarra Standard	Mature	273	9,101	4·2	388
†Blacklands Fairy 30th	Parkview Alexander	S.2	273	6,770	4·1	283
†Wonga Lady Sunspray	Reservoir Yenda	J.2	273	5,260	4·6	245
[illegible]	[illegible]	[illegible]				

COX AND SONS, F. J., Crawford (Jersey, 8).						
Rosel Royal Lass	Rosel Solid Gold	Mature	273	6,313	5·1	325
Rosel Esther	Bellefaire Blondes Bullion	Mature	273	6,929	5·8	403
Rosel Midget	Rosel Solid Gold	J.4	273	4,917	5·2	260
Rosel Elma	Rosel Solid Gold	S.3	273	3,014	5·8	176
Rosel Caroline	Rosel Solid Gold	J.3	273	5,447	4·9	272
Rosel Ellen	Rosel Solid Gold	S.2	273	5,525	5·5	309
Rosel Vénus	Belmont Royal Peer	J.2	273	5,086	5·1	264
Rosel Princess 2nd	Belmont Royal Peer	J.2	273	4,142	4·8	200
CRAMB, S. A., Caboolture (Jersey, 3).						
†Fauvic Sunnymorn	Navua Kahokas Lad	Mature	365	9,977	5·1	515
†Fauvic Marmay	Condong Marabean	Mature	273	7,981	5·0	405
†Fauvic Marmay	Condong Marabean	Mature	365	10,252	4·9	512
Fauvic Red Bait	Shepstone Gallant Lad	Mature	273	7,761	4·5	355
CRANNEY, A. J., Maleny (Guernsey, 8).						
Fernhill Prairie Flower	Cooroora View Plaintiff	Mature	273	7,870	5·2	413
Fernhill Vida	Laureldale Violet's Sequel	J.3	273	6,654	5·1	342
Fernhill Jessica	Laureldale Violet's Sequel	J.3	273	5,234	5·6	296
Fernhill Lustre	Wollongbar Remus	J.2	273	6,399	4·9	318
Fernhill Bud	Laureldale Pluto	Mature	273	6,132	5·4	337
Fernhill Boquet	Fernhill Barrister	Mature	273	6,516	5·0	327
Fernhill Posey	Laureldale Violet's Sequel	J.3	273	5,817	5·6	328
Fernhill Jennifer	Wollongbar Remus	J.2	273	6,302	4·9	309
CRAWFORD, R. J., Kingaroy (Jersey, 1).						
†Inverlaw Royal Phyllis	Oxford Royal Lad	S.4	273	6,725	5·5	374
DAVIS, W., Wambo (A.I.S., 7).						
†Bunyaview Thelma's Pride	Bingleigh Royal	Mature	273	10,583	4·2	448
†Bunyaview Reflection's Rosette	Trevor Hill Reflection	J.3	273	9,248	3·7	350
†Fairvale Doris 13th	Fairvale Reward	J.3	273	7,221	4·6	327
†Faversham Dawn	Girraween Gideon	J.2	273	7,179	3·6	265
†Wamba Evelyn 2nd	Greyleigh Eros	J.2	273	6,229	3·9	245
†Calrossie Empress 5th	Ehlma Park Bosca	Mature	273	8,778	4·2	372
†Yarranvale Gentle	Trevor Hill Bosca	Mature	273	8,489	4·3	367

TABLE 11—*continued.*

RECORDS OF COWS COMPLETING LACTATION RECORDS DURING THE YEAR ENDED 30TH JUNE, 1950—*continued.*

Cow.	Sire.	Age.	Days Recorded.	Production. Milk.	Test.	Butterfat.
				Lb.	%	Lb.
	DAY, V. S., Veresdale (A.I.S., 2).					
†Dnalwon Rosamond 3rd	Dnalwon Fiction	Mature	273	12,088	3·4	419
†Millstream Beryl 16th	Sunnyview Bruce	J.3	273	10,483	3·5	367
	DERRICK, F., Moonford (A.I.S., 9).					
†Derradale Judy	Sunnyview Royal Ruler	J.2	273	6,837	4·0	275
†Cedargrove Ella 9th	Rosenthal Scout	J.3	273	8,659	4·0	348
†Cedargrove Ellen 36th	Rosenthal Scout	S.2	273	8,475	3·5	302
†Applegarth Posy 10th	Fairholm Evidence	J.2	273	6,357	3·8	244
†Applegarth Rosebud 9th	Fairholm Evidence	J.2	273	7,261	3·7	272
†Cedargrove Lady Prim 21st	Rosenthal Scout	J.3	273	8,324	4·1	342
†Cedargrove Wonder 44th	Rosenthal Scout	J.3	273	8,792	3·8	340
†Cedargrove Strawberry 21st	Rosenthal Scout	J.3	273	7,343	4·2	312
†Applegarth Mavis 8th	Fairholm Evidence	J.2	273	8,705	3·6	316
	DOHERTY, Estate P., Gympie (A.I.S., 7).					
†Glen Idol Miss Jean 3rd	Glen Idol Coronet	J.2	273	9,528	3·7	356
†Glen Idol Countess 7th	Blacklands True Blue	S.3	273	7,611	4·2	321
†Glen Idol Lady Gentle	Glen Idol Charmer	S.2	273	8,645	3·4	298
†Glen Idol Thelma 11th	Glen Idol Charmer	J.2	273	7,365	3·7	274
†Blacklands Lady Gentle 14th	Blacklands Czar	Mature	273	10,925	4·4	484
†Glen Idol Florrie 17th	Blacklands True Blue	J.3	273	9,790	3·9	382
†Glen Idol Daphne 25th	Glen Idol Regent	S.3	273	11,607	4·3	511
	DONAGHY, P. J., Malanda (A.I.S., 8).					
†Learmont Beauty	Sunnyview Melba's Hero	S.2	273	9,171	4·2	388
†Learmont May 4th	Sunnyview Melba's Hero	J.4	273	11,696	4·2	498
†Learmont Shiny	Sunnyview Melba's Hero	S.3	273	11,140	4·3	488
†Learmont Lovely	Alfa Vale Pride 18th	J.4	273	8,485	5·0	428
†Learmont Young Posey	Alfa Vale Pride 18th	J.3	273	7,249	4·0	296
†Learmont Dolly	Alfa Vale Pride 18th	J.3	273	6,421	4·2	275
†Learmont Poppy	Sunnyview Melba's Hero	S.2	273	9,359	3·6	344
†Learmont Pearl	Alfa Vale Pride 18th	J.2	273	7,094	4·1	291

DOSS, W. H., Degilbo (Guernsey, 6).						
Oakwood Girleen	Fairfield Witch Boy	Mature	273	8,442	4·3	366
Oakwood Nita	Fairfield Winner	S.3	273	4,999	5·3	266
San Jonda Rose	Fairfield Winner	S.2	273	5,817	4·7	276
Oakwood Honour	Fairfield Winner	J.3	273	6,857	4·7	326
Oakwood Judy	Wollongbar Sapper	Mature	273	5,294	5·4	286
Laureldale Pendant	Minnamurra Topsy's Sequel 2nd	Mature	273	5,643	5·1	289
DUNNING AND SONS, E. J., Stanmore (Jersey, 1).						
†Elwyn Golden Molly	Glenside Lone Star	Mature	273	7,446	5·0	376
EDWARDS BROS., Kingaroy (A.I.S., 2).						
†Bunya View Scarlet 2nd	Trevor Hill Reflection	S.4	273	10,720	4·6	495
†Bunya View Scarlet 2nd	Trevor Hill Reflection	S.4	365	13,386	4·5	611
†Spring Valley Dahlia	Aynesley Charmer	J.2	273	8,509	3·5	299
ENGLISH AND SONS, J., Malanda (A.I.S., 1).						
†Eachamvale Queen	Eachamvale Standard	Mature	273	11,294	4·0	457
EVANS, I. J. L., Cooroy (Jersey, 2).						
†Kenilworth Midget	Rosevale War Bond	J.3	273	6,298	5·5	349
†Kenilworth Nellie	Rosevale War Bond	J.3	273	7,352	5·2	383
EZZY, A. F., Mount Emlyn (A.I.S., 1).						
Nullabowry Olive	Jamberoo Brigadier	J.2	120	1,683	3·9	66
FARM HOME FOR BOYS, Westbrook (Jersey, 14).						
†Westbrook Bells 14th	Westbrook Ambassador 52nd	S.4	273	7,552	4·7	360
†Westbrook Tulip 143rd	Selsey Royal Standard	J.3	273	6,544	5·3	347
†Westbrook Tulip 148th	Westbrook Comet 17th	S.2	273	6,355	5·0	322
†Westbrook Bells 18th	Westbrook Comet 17th	S.2	273	5,693	5·4	310
†Westbrook Sylvia 26th	Mornmoot Clementine's Valour	J.2	273	6,473	4·5	296
†Westbrook Silvermine 3rd	Westbrook Comet 26th	J.2	273	5,735	4·8	278
†Westbrook Sylvia 27th	Westbrook Silvermine's Valour	J.2	273	6,093	4·5	276
†Westbrook Wyandotte 11th	Westbrook Silvermine's Valour	J.2	273	4,523	5·0	230
Westbrook Silvermine 4th	Mornmoot Clementine's Valour	J.2	273	6,659	5·0	336
Westbrook Tulip 134th	Mornmoot Clementine's Valour	Mature	273	10,166	5·3	545
Westbrook Sultane 13th	Mornmoot Clementine's Valour	J.2	273	5,072	4·7	242
Westbrook Safety 39th	Westbrook Comet 26th	J.2	273	4,680	4·8	229
Westbrook Pearl 5th	Westbrook Comet 17th	S.3	273	5,756	5·5	320
Westbrook Bells 19th	Westbrook Silvermine's Valour	J.3	273	4,975	4·6	231

TABLE 11—*continued.*

RECORDS OF COWS COMPLETING LACTATION RECORDS DURING THE YEAR ENDED 30TH JUNE, 1950—*continued.*

Cow.	Sire.	Age.	Days Recorded.	Production. Milk.	Test.	Butterfat.
				Lb.	%	Lb.
FOGG, J. H., Toogoolawah (A.I.S., 2).						
Aynesley Gem 14th	Valera Daphne's Pride 3rd	J.2	273	5,594	4·2	235
Cedar Valley Rosette	Kyabram Masterpiece	J.3	273	10,066	4·0	406
FOWLER, T. W., Pittsworth (A.I.S., 2).						
†Trevor Hill Vena	Fairvale Jellicoe	J.2	365	14,159	4·1	594
†Jamberoo Sadie 6th	Murray Bridge Florrie's Prince	J.4	273	9,869	3·6	361
FOXTON, E. G., Maleny (Guernsey, 13).						
†Linwood Birdie	Linwood Rex	Mature	273	7,548	5·5	419
†Toba Choice	Wirrawong Winter	J.2	273	5,431	4·9	269
†Toba Butterfly	Wirrawong Winter	J.2	273	4,118	5·8	240
†Linwood Sonia	Wirrawong Winter	J.3	273	5,882	4·7	279
†Toba Marie	Wirrawong Winter	J.2	273	6,379	4·4	281
†Toba Bettina	Koojan Ace's Marshall	J.2	273	5,021	4·9	250
†Toba Pansy	Linwood Hurricane	J.2	273	4,817	5·0	241
†Toba Cissie	Linwood Hurry	S.2	273	6,450	4·4	286
†Toba Secret	Linwood Hurricane	J.2	273	5,087	4·7	240
Linwood Sister	Laureldale Peaceboy	Mature	273	9,083	4·9	453
Linwood Silver	Laureldale Peaceboy	Mature	273	7,257	4·8	352
Linwood Pretty	Wirrawong Winter	S.4	273	7,968	4·8	386
Linwood Serene	Wirrawong Winter	S.3	273	6,953	5·2	363
FRENCH, W. R., Wowan (Jersey, 2).						
†Mountain View Seaspray	Pineview Beryl's King	Mature	273	7,062	5·5	395
†Mountain View Maiden	Brookland Crumpet	J.3	273	7,673	5·1	398
GIERKE AND SONS, W., Helidon (A.I.S., 1).						
†Rhodesview Royal Primrose 6th	Alfa Vale Nigel	J.3	273	9,042	4·0	366

		GILES BROS., Woowoonga (A.I.S., 2).				
†Merridale Dimple	Blacklands Heir	Mature	273	11,686	4·0	471
†Merridale Dell 2nd	Blacklands Oxford	J.3	273	8,067	3·8	309
		GRANT, A. S., Greenwood (Jersey, 3).				
†Hillsdale Charm	Rosallen Laddie	S.2	273	5,445	5·7	313
†Hillsdale Eileen	Rosallen Laddie	S.2	273	5,613	5·0	285
†Mount Carmel Silver Moonbeam	Hocknell Volunteer Bounce	J.2	273	4,681	5·1	239
		GRASMERE JERSEY STUD FARM, Neurum (Jersey, 8).				
Glenview Faith	Trinity Governor's Hope	Mature	273	5,282	5·5	294
Grasmere Victory's Pontorson	Oxford Brown Victory	S.4	240	4,860	6·1	299
Grasmere Lynn's Sultane	Grasmere Lady Lynn's Victory	J.2	273	4,700	5·3	252
Grasmere Lynn's Dewdrop	Grasmere Lady Lynn's Victory	J.2	273	4,812	5·1	248
Grasmere Lynn's Gloria	Grasmere Lady Lynn's Victory	J.2	273	3,310	5·2	172
Grasmere Victory Charm	Oxford Brown Victory	S.4	273	6,129	6·1	378
Grasmere Lynn's Coral	Grasmere Lady Lynn's Victory	J.2	273	4,804	5·8	252
Grasmere Lynn's Colleen	Grasmere Lady Lynn's Victory	J.2	240	3,366	5·0	170
		GRIFFITHS, R. S., Moregatta (A.I.S., 13).				
†Fernhome Beryl	Merravale Gentle's Commodore	J.3	273	6,759	4·4	301
†Fernhome Maytime	Glengarry Gem's Royal	Mature	273	8,813	4·2	377
†Fernhome Goodluck	Glengarry Gem's Royal	Mature	273	7,903	4·7	374
†Fernhome Tiny	Merravale Gentle's Commodore	S.3	273	7,780	4·2	332
†Fernhome Lottie	Rosenthal Compensation	Mature	273	7,842	4·5	360
†Fernhome Gail	Glengarry Gem's Royal	Mature	273	7,340	4·8	359
†Fernhome Francis	Glengarry Gem's Royal	S.3	273	5,622	5·4	305
†Fernhome Cecile	Glengarry Gem's Royal	J.3	273	6,554	5·1	337
†Fernhome Bonnie	Glengarry Gem's Royal	S.3	273	8,508	4·5	387
†Fernhome Moira	Merravale Gentle's Lovely	S.3	273	8,046	4·5	369
†Fernhome Etta 2nd	Glengarry Gem's Royal	J.3	273	7,315	4·3	317
Fernhome Fay	Merravale Gentle's Commodore	J.3	273	6,958	4·0	284
Fernhome Fawn	Glengarry Gem's Royal	Mature	273	10,731	4·3	465

TABLE 11—*continued.*

RECORDS OF COWS COMPLETING LACTATION RECORDS DURING THE YEAR ENDED 30TH JUNE, 1950—*continued.*

Cow.	Sire.	Age.	Days Recorded.	Production. Milk.	Test.	Butterfat.
				Lb.	%	Lb.
	HARLEY, G., Childers (Jersey, 4).					
†Trinity Cute Maisie	Trinity Cute Prince	Mature	273	7,288	5·0	370
†Trinity Dreamaway 2nd	Trinity Royal Sovereign	Mature	273	7,359	4·6	344
Hopewell Dreamlass	Trinity Daffodil's Design	J.3	273	5,967	4·7	284
Hopewell Olivia's Opal 2nd	Trinity Daffodil's Design	J.3	273	5,224	5·7	298
	HARMER, L. E., Beaudesert (Jersey, 3).					
†Laurena Lady Belle	Brookland Merry Signaller	J.2	273	4,647	4·9	231
†Hocknell Volunteer Ginger Cake	Navua Sporting Volunteer	S.3	273	7,031	5·6	394
†Laurena Royal Tulip	Golden View Some Hope	S.2	273	5,867	5·1	301
	HART BROS., Clifton (A.I.S., 5).					
†Jamberoo Marjorie 10th	Murray Bridge Florrie's Prince	Mature	273	12,751	4·0	520
†Bileena Choice 3rd	Tara Governor	Mature	273	11,070	3·6	407
†Bileena Bonnie 10th	Tara Governor	Mature	273	10,802	3·5	387
†Jamberoo Glory 6th	Valiant of Greyleigh	Mature	273	11,800	3·2	381
†Jamberoo Crummy 3rd	Valiant of Greyleigh	Mature	273	9,194	4·0	375
	HARVEY, C. and B., Nobby (A.I.S., 2).					
White Park Thelma 41st	White Park Bruce	J.3	273	8,866	4·2	378
White Park Moss 40th	White Park Radiant	S.2	273	5,146	4·1	213
	HENRY, K., Greenmount (A.I.S., 11).					
†Tara Cleo 6th	Alfa Vale Plumber	J.2	273	7,109	4·1	298
†Tara Cleo 3rd	Tara Magnet's Gift	Mature	273	9,215	4·6	432
†Tara Magnet 3rd	Alfa Vale Plumber	Mature	273	9,837	3·9	386
†Tara Laura 7th	Tara Osiris	Mature	273	9,412	3·9	369
†Tara Cinderella 2nd	Alfa Vale Plumber	Mature	273	7,898	4·4	355
†Tara Cleo 5th	Alfa Vale Plumber	S.3	273	7,076	4·6	327
†Tara Isis 6th	Alfa Vale Plumber	S.3	273	8,108	3·7	304
†Tara Isis 8th	Alfa Vale Plumber	J.3	273	7,722	4·3	337
†Tara Hilda 4th	Alfa Vale Plumber	S.2	273	6,814	4·1	285
Tara Laura 9th	Alfa Vale Plumber	Mature	240	8,229	4·0	330
Tara Jewel 6th	Alfa Vale Plumber	Mature	240	7,551	4·0	308

HENSCHELL, W., Yarranlea (A.I.S., 13).

†Yarranvale Empress	Trevor Hill Bosca	Mature	273	12,964	3·7	481
†Yarranvale Jean	Trevor Hill Bosca	J.3	273	6,803	4·0	274
Fairvale Ethel 13th	Fairvale Reward	J.4	210	5,661	3·7	213
Yarranvale Peggy	Fairvale Reward	J.3	240	6,550	3·6	237
†Yarranvale Minerva 3rd	Fairvale Jeweller	J.2	234	6,101	4·0	244
Yarranvale Snow Queen	Fairvale Jeweller	J.2	273	5,903	3·8	227
Yarranvale Lady May	Fairvale Jeweller	J.2	273	6,122	3·6	223
Yarranvale Minerva 2nd	Fairvale Jeweller	J.2	210	5,580	3·8	213
*Fairvale Laurel 2nd	Bingleigh Jean's Monarch	Mature	273	23,094	3·6	853
*Trevor Hill Bonnie	Trevor Hill Bosca	Mature	273	18,685	4·1	775
*Fairvale Myrtle 7th	Fairvale Dairy Lad	J.3	273	8,198	3·9	321
*Yarranvale Pride	Fairvale Jeweller	J.2	273	7,976	4·2	342
Yarranvale Handsome	Fairvale Jeweller	J.2	273	6,920	4·1	286

HERZIG, R., Clifton (A.I.S., 3).

†Talgai Vale Crummy	Jamberoo Butter Boy	J.2	273	7,956	4·0	325
Jamberoo Winnie 9th	Murray Bridge Florrie's Prince	S.4	273	8,937	3·5	316
Jamberoo Winnie 10th	Jamberoo Prodigal	J.4	273	9,746	3·9	386

HINRICHSON AND SONS, Clifton (A.I.S., 7).

†Ardilea Mayflower	Ardilea Socialist	J.2	273	5,169	4·5	236
†Ardilea Nellie 5th	Newstead Musician	S.2	253	7,207	4·0	290
Ardilea Princess 4th	Newstead Reliance	J.4	273	7,967	4·1	328
Ardilea Flower 17th	Newstead Musician	Mature	273	8,724	3·8	333
Ardilea Gwen 9th	Newstead Musician	S.3	273	6,934	3·7	259
Ardilea Nellie 6th	Newstead Royal Monitor	J.2	273	7,603	3·8	290
Ardilea Velvet 4th	Newstead Admiral	J.2	273	5,812	4·0	237

HOLMES, L., Yarranlea (Ayrshire, 13).

†Benbecula Lady Bliss	Benbecula Tina's Willie	Mature	273	8,140	4·3	355
†Benbecula Theresa	Benbecula Marquis	J.3	273	7,693	3·6	283
†Benbecula Luxurious	Myola Jean's Monarch	Mature	273	9,746	3·8	374
†Benbecula Thistledown	Benbecula Marquis	J.3	273	7,544	3·7	283
†Benbecula Tranquil	Benbecula Marquis	J.2	273	7,614	4·0	310
Benbecula Judy 2nd	Benbecula Marquis	Mature	273	8,870	3·8	341
Benbecula Bernadette	Benbecula Marquis	J.4	240	7,949	4·0	325
Benbecula Bettine	Benbecula Marquis	S.3	273	6,276	4·0	256
Benbecula Eunice	Benbecula Marquis	S.2	240	4,962	4·2	211
Benbecula Juniper	Benbecula Tony	J.2	240	3,348	3·9	132
Benbecula June	Benbecula Tony	J.2	180	2,760	3·7	104
Benbecula Suzanne	Benbecula Marquis	J.2	180	2,208	3·9	87
Benbecula Fleurette	Benbecula Marquis	S.2	273	6,181	3·7	234

TABLE 11—*continued.*

RECORDS OF COWS COMPLETING LACTATION RECORDS DURING THE YEAR ENDED 30TH JUNE, 1950—*continued.*

Cow.	Sire.	Age.	Days Recorded.	Production. Milk.	Test.	Butterfat.
				Lb.	%	Lb.
	HORROCKS, W. J., Maclagan (A.I.S., 6).					
†Grahamville Sapphire	White Park Ronald	J.3	273	7,185	4·2	306
†Bunyaview Mafalda 7th	Trevor Hill Progress	S.3	273	7,494	4·1	308
Grahamville Jewel	Mountain Home Gem 16th	J.2	273	8,312	2·9	247
Grahamville Susie	Sunnyview Principle	S.2	210	4,350	3·4	152
Grahamville Golden	Sunnyview Principle	J.2	240	5,550	3·6	205
Grahamville Rose	White Park Ronald	J.2	210	3,705	4·0	151
	HUEY, C., Sabine (Jersey, 9).					
†Ashview Golden Peal	Trecarne Victor 4th	J.2	273	4,917	4·7	232
†Ashview Gift	Trecarne Victor 4th	J.3	273	5,375	5·2	288
†Ashview Hazeldale	Trecarne Some Tot's Duke 2nd	S.2	273	5,960	5·2	312
†Ashview Queen 3rd	Trecarne Victor 4th	S.2	273	5,226	4·8	256
†Ashview Locket 3rd	Trecarne Victor 4th	J.4	273	8,290	5·2	434
†Ashview Ladyette 2nd	Trecarne Some Tot's Duke 2nd	J.2	273	5,567	4·9	276
Ashview Lady 3rd	Trecarne Victor 4th	Mature	273	5,369	5·7	309
Ashview Some Lady	Trecarne Some Tot's Duke 2nd	S.2	273	4,874	5·7	282
Ashview Some Lady 2nd	Trecarne Some Tot's Duke 2nd	J.2	273	6,630	4·8	323
	HUTH, A. A., Roadvale (Guernsey, 3).					
†Brynworth Peace Lady	Moongi Bonnie Willie	J.2	273	5,221	4·6	242
†Brynworth Charm	Moongi Bonnie Willie	J.2	273	5,160	4·6	241
Brynworth Charm	Moongi Bonnie Willie	J.3	273	5,069	5·5	284
	HUTTON, D. R., Cunningham (Jersey, 6).					
†Bellgarth Royal Lady	Romsey Spotted King	J.3	273	6,300	5·8	366
†Bellgarth Golden Gwen	Trinity Gleaming Effort	S.2	273	5,787	5·0	294
†Bona Vista Roselie	Belgonia Standard	S.2	273	4,426	5·7	253
†Bellgarth Lady Gleam	Trinity Gleaming Effort	S.2	273	4,599	5·4	250
†Bellgarth Fairy 6th	Trinity Gleaming Effort	J.2	273	4,498	6·1	276
†Bona Vista Apollo's Shamrock	Belgonia Apollo	J.2	273	5,600	5·1	287

H. M. STATE FARM, Palen Creek (Jersey, 1).						
†Palen Bluebell 2nd	Westbrook Ambassador 51st	J.4	273	6,481	4·8	313
JACKSON, E. W., Nobby (A.I.S., 5).						
†Ennismore Fuschia 2nd	Navillus Prince Henry	S.3	273	7,542	4·1	310
†Ennismore Flora	Navillus Prince Henry	S.3	273	7,553	4·0	303
†Ennismore Bud 3rd	Ardilea Ossie	J.3	273	7,747	4·6	364
†Ennismore Rosemarie 2nd	Arolla Limerick	J.2	273	7,431	4·7	353
*Ennismore Tiddlewinks	Arolla Limerick	J.2	240	6,108	3·6	222
JOHNSON, H., Gleneagle (Jersey, 3).						
†Windsor Princess Florence	Bobs of Wingate	S.3	273	6,575	5·7	377
†Windsor Royal Melody	Brookland Merry Monarch	J.2	273	5,550	5·5	306
Windsor Royal Rhondda	Brookland Merry Monarch	J.3	273	7,247	4·6	337
JOHNSTON, D. C., Beaudesert (Guernsey, 8).						
†Fernhill Queen Anne	Laureldale Violet's Sequel	J.2	273	6,322	5·0	317
†Oakwood Winkie	Fairfield Winner	S.4	273	6,830	5·7	394
†Fernhill Rose Royal	Cooroora View Chance	J.3	273	6,939	5·1	356
†Oakwood Pam	Fairfield Winner	S.3	273	8,614	4·3	376
†Oakwood Biddy	Fairfield Winner	S.4	273	7,650	4·8	372
†Fernhill Golden Laurel	Cooroora View Pilgrim	Mature	273	8,303	4·8	400
†Fernhill Peacebelle	Wollongbar Remus	J.2	273	5,771	5·4	312
†Toba Brightly	Linwood Hurricane	J.2	273	6,634	4·6	307
JOHNSTON, R. D., Kingaroy (Jersey, 6).						
†Mannuem Cosmos 2nd	Nimbrae Promoter	S.3	273	8,135	5·8	474
†Gunawah Skylark	Austral Park Montrose Blue	S.3	273	7,543	4·8	368
Gunawah Fraulein	Austral Park Montrose Blue	J.2	273	6,463	5·3	348
Keystone Cosmos 2nd	Bonnie Vue Gay Peer	Mature	273	7,301	5·2	381
Gunawah Suzelle	Austral Park Montrose Blue	J.2	273	6,296	5·0	319
Mannuem Dulcie 2nd	Kathleigh Bunty King	J.2	273	3,895	5·0	198

TABLE 11—*continued.*

RECORDS OF COWS COMPLETING LACTATION RECORDS DURING THE YEAR ENDED 30TH JUNE, 1950—*continued.*

Cow.	Sire.	Age.	Days Recorded.	Production.		
				Milk.	Test.	Butterfat.
				Lb.	%	Lb.
KAJEWSKI, W., Glencoe (A.I.S., 13).						
†Glenroy Enid	Blacklands Sheik	Mature	273	8,944	4·4	396
†Glenroy Princess	Blacklands Sheik	S.4	273	8,034	4·7	382
†Glenroy Jane	Fairholm Lewis	S.3	273	7,233	4·6	334
†Glenroy Bangle	Cosey Camp Ida's Patron	S.2	273	7,696	4·3	333
†Glenroy Eleanor	Fairholm Lewis	S.2	273	7,124	4·4	313
†Glenroy Minnie	Fairholm Lewis	S.2	273	7,176	4·3	310
†Glenroy Bloss	Fairholm Lewis	S.2	273	5,474	5·3	295
†Glenroy Eunice	Fairholm Lewis	S.2	273	6,073	4·6	285
†Glenroy Sally 2nd	Fairholm Lewis	S.2	273	5,984	4·5	273
†Glenroy Eileen	Fairholm Lewis	S.2	273	5,809	4·6	269
†Glenroy Pearl	Fairholm Lewis	S.2	273	6,252	4·2	268
†Glenroy Birdie	Fairholm Lewis	S.4	273	9,752	4·4	434
†Glenroy Show Lass	Fairholm Lewis	J.2	273	6,072	4·6	285
KATH, F. W., Moffatt (Jersey, 4).						
†Trinity National Daffodil	Trinity National Victory	J.3	273	6,986	5·5	387
†Kathleigh Silversheen	Kathleigh Masterman	J.2	273	7,612	5·7	438
†Kathleigh Noble's Rosemary	Oxford Fawn's Noble	J.2	273	7,703	5·4	416
†Kathleigh Pontorson	Oxford Fawn's Noble	J.2	273	6,689	5·5	369
KERLIN, P., Killarney (Jersey, 14).						
†Glenrandle Golden Girl	Bellgarth Stylish	Mature	273	7,793	5·3	420
†Glenrandle Lucy	Bellgarth Glory King	Mature	273	7,015	5·4	384
†Glenrandle Lulu	Oxford Noble Peer	J.3	273	7,861	5·6	444
†Glenrandle Dairymaid	Bellgarth Stylish	Mature	273	7,440	6·0	453
†Bellgarth Bluebird	Bellgarth Victory	S.3	273	5,653	5·7	327
†Glenrandle Joan	Gem Rodney	J.2	273	7,048	5·4	387
†Glenrandle Winsome Lady	Gem Rodney	J.2	273	6,021	6·0	364
†Glenrandle Fair Lassie 2nd	Gem Rodney	J.2	273	5,452	6·1	337
†Glenrandle Fashion Lady	Bellgarth Stylish	Mature	273	6,416	5·6	361
†Glenrandle Spotted Lady	Oxford Noble Peer	J.4	273	7,321	5·9	436
†Glenrandle Chimes	Bellgarth Glory King 2nd	J.3	273	6,703	5·0	336
†Glenrandle Brown Maid	Waltham Farm Brown Boy	S.2	273	6,232	4·7	298
†Glenrandle Evenbelle 2nd	Gem Rodney	J.2	273	5,239	5·3	282

	KLEIN BROS., Ma Ma Creek (A.I.S., 1).					
†Blacklands Lily 13th	Sultan 2nd of Blacklands	Mature	273	9,920	3·6	361
	LANE J. A., Kilcoy (A.I.S., 2).					
†Greenhill Polly 11th	Coral Grange Darby	S.2	273	11,610	3·0	343
†Sunnyview Rose Petal	Sunnyview Kitchener	J.2	273	6,689	3·9	265
	LESTER, M. C., Glengallan (A.I.S., 11.)					
†St. Andrew's Violet	Bingleigh Premier	J.3	273	10,682	4·4	471
†St. Andrew's Gem 10th	Tabbagong Victory	S.2	273	8,685	4·0	350
†St. Andrew's Gem 11th	Tabbagong Victory	S.2	273	8,333	3·8	318
†St. Andrew's Gem 19th	Tabbagong Victory	J.2	273	9,852	3·4	338
†St. Andrew's Envy	Tabbagong Victory	J.2	273	7,920	3·8	305
†St. Andrew's Gentle	Tabbagong Victory	J.2	273	7,517	3·9	296
*St. Andrew's Gem 15th	Tabbagong Victory	S.2	240	7,939	4·1	331
*St. Andrew's Gem 16th	Tabbagong Victory	S.2	240	6,278	4·4	278
*St. Andrew's Olive	Tabbagong Victory	J.2	273	8,749	4·2	373
*St. Andrew's Ivy 2nd	Tabbagong Victory	J.2	210	5,388	4·1	226
*St. Andrew's Gem 18th	Tabbagong Victory	J.2	273	6,079	3·8	233
	LITHGOW, D. L., Jandowae (A.I.S., 1).					
†Calrossie Camelia 2nd	Aynesley Eclipse 3rd	S.2	273	6,240	4·4	279
	LITTLETON, H. V., Crow's Nest (A.I.S., 11).					
†Faversham Doris 40th	Girraween Gideon	J.2	273	6,911	4·1	287
Wongalea Beauty 2nd	Valera Daphne's Prince 2nd	S.2	180	4,425	3·6	162
Faversham Ruby 10th	Croydon Marchese	Mature	273	7,565	3·6	276
Balcarres Matilda 5th	Valera Daphne's Prince 2nd	S.4	273	6,498	3·6	240
Faversham Dewdrop 41st	Girraween Gideon	S.2	273	5,521	3·5	195
Calrossie Gem 13th	Alfa Vale Nodule	J.2	240	4,320	3·6	158
Balcarres Madam 8th	Balcarres Major 4th	S.3	273	5,541	4·1	229
Balcarres Lady Primrose 4th	Balcarres Bachelor	J.3	273	4,999	3·9	198
Wongalea Heather	Balcarres Major 4th	S.2	273	5,885	3·8	227
Wongalea Bluebelle	Balcarres Major 4th	S.2	273	4,804	4·0	192
Wongalea Killarney 2nd	Valera Daphne's Prince 2nd	S.2	273	3,695	3·9	144
	LOHSE, A., Biggenden (A.I.S., 3).					
†Alascan Sally	Alfa Vale Review	J.2	273	7,386	3·7	276
†Alascan Hazel	Alfa Vale Review	S.2	273	7,691	4·1	319
†Sunnyview Roan Fairest	Newstead Ambassador	J.3	273	8,233	3·5	294

TABLE 11—*continued.*

RECORDS OF COWS COMPLETING LACTATION RECORDS DURING THE YEAR ENDED 30TH JUNE, 1950—*continued.*

Cow.	Sire.	Age.	Days Recorded.	Production. Milk.	Test.	Butterfat.
				Lb.	%	Lb.
	LOUTTIT, D. J., Moonford (Jersey, 4).					
†Boree Effort's Briar	Trinity Daffodil's Effort	J.2	365	12,411	4·9	616
†Trinity Crowning Meadowsweet	Trinity Crowning Effort	Mature	273	9,173	5·2	479
†Glenview Brittannia	Trinity Governor's Hope	Mature	273	8,490	5·4	459
†Hazeldean Springtime	Glenview Crusader	Mature	273	8,232	5·0	413
	LOVELL, J. F., Samford (Jersey, 3).					
†Tarana Lady Nell	Lermont Golden Victory	J.3	273	5,984	4·6	281
†Tarana Lady Au-Lynne	Oxford Bruno	J.2	273	5,214	5·2	272
Tarana Sweet Rosalee	Oxford Bruno	J.2	273	6,885	4·5	315
	LYNCH, S. A., Gurgeena (Jersey, 1).					
Boree Efforts Harebell	Trinity Daffodil's Effort	J.2	273	5,661	5·6	318
	MADGE BROS., Southbrook (A.I.S., 9).					
Trevor Hill Primrose 8th	Fairvale Jellicoe	J.4	273	9,563	4·0	390
Emby Vale Velvet	Barkworth Master	J.3	273	15,464	4·0	631
Emba Vale Dainty	Braemar Ringleader	S.2	273	8,441	3·9	335
Arolla Premier's Ellen	Bingleigh Premier	S.2	273	8,129	3·7	308
Emby Vale Gentle	Braemar Ringleader	J.2	273	8,273	4·3	359
Trevor Hill Deb	Trevor Hill Bosca	J.2	273	7,998	4·3	349
Bantry Nectar 2nd	Bantry Commodore	J.2	273	8,336	4·0	337
Trevor Hill Eclipse's Iris	Trevor Hill Eclipse	J.2	273	8,219	3·9	325
Emby Vale Velvet 2nd	Barkworth Master	J.2	273	7,218	3·9	287
	MANN, N. J., Broxburn (Ayrshire, 9).					
†Crescent Farm Annabelle	Myola Orphan Boy	J.2	273	9,964	3·6	359
†Crescent Farm Joyous	Myola Orphan Boy	J.4	273	10,848	3·7	411
†Crescent Farm Monnie	Myola Orphan Boy	S.2	273	9,683	4·2	415
†Crescent Farm Pussy	Myola Orphan Boy	S.2	273	7,259	3·8	277
†Crescent Farm Venice	Crescent Farm Bell Boy	J.2	273	7,755	3·6	286
Crescent Farm Joycey	Myola Orphan Boy	Mature	273	11,637	3·4	396
Crescent Farm Peggy's Love	Crescent Farm Bell Boy	J.2	273	7,131	3·7	267
Crescent Farm Winsome	Crescent Farm Bell Boy	J.2	273	6,410	3·9	255
Crescent Farm June 3rd	Crescent Farm Bell Boy	J.2	273	6,759	3·7	251

	MARSDEN, L. E., Canaga (Jersey, 6).					
†Woodview Elaine	Woodview Officer	J.2	273	3,914	5·9	231
Woodview Montrose	Trecarne Royal Officer	J.2	273	4,211	5·8	245
Ashview Rosamond 2nd	Trecarne Some Tot's Duke 2nd	J.2	273	3,678	5·6	209
Woodview Sweet Lady 2nd	Ashview Peer	J.2	273	4,919	5·5	274
Woodview Birdie	Ashview Peer	S.2	273	5,774	5·4	316
Woodview Fairy Lass	Woodview Officer	S.2	273	4,951	4·7	236
	MARQUARDT, A. C., Mondure (A.I.S., 5).					
*Cedar Valley Lass	Kyabram Masterpiece	Mature	273	10,579	3·1	333
Cedar Valley Joan	Kyabram Masterpiece	J.3	273	5,383	3·6	197
Cedar Valley Pansy 3rd	Kyabram Masterpiece	S.2	273	8,108	3·9	323
Happy Valley Linda's Pride	Newstead Ludlow	S.2	273	6,801	3·8	261
Cedar Valley Fay	Kyabram Masterpiece	J.2	273	6,611	3·5	232
	MASSAM, L., Gleneagle (Jersey, 2).					
†Laurena Majesty Belle	Golden View One More	J.2	273	5,943	4·4	267
†Viewmont Lady Evelyn	Windsor Sultan Leslie	J.3	273	5,458	5·3	290
	MATTHEWS, E. A., Yarraman (Jersey, 2).					
Yarradale Petal	Smythesdale Bruce	S.2	273	6,108	4·6	283
Inverlaw Wild Rose	Oxford Royal Lad	Mature	273	6,635	4·3	292
	MAY, M., Hermitage (Jersey, 2).					
†Grasmere Noble Gleam	Springhurst Noble Oak	S.2	273	6,267	4·3	274
Grasmere Elaine's Monica	Grasmere Elaine's Victory	S.2	60	969	4·9	48
	McCARTHY, J., Greenmount (Jersey, 10).					
†Glen Erin Viola	Ashfield Prometheus	J.2	365	7,318	5·5	405
†Ellerdale Watfern Berenice	Ellerdale Watfern Gamboge	J.2	273	5,721	6·1	351
†Trinity Cute Daffodil 2nd	Samares Cute Prince 3rd	Mature	273	7,355	6·3	464
†Sunny Glen Nellie	Ivy Bank Lad	J.3	273	5,867	6·2	364
†Lermont Model 2nd	Trinity Noble Effort	S.4	273	6,599	6·3	419
Rosallen Marlene	Navua Doreen's Royalist	J.3	273	6,873	5·2	362
Rosallen Vida	Navua Doreen's Royalist	J.3	273	6,210	5·1	318
Glen Erin Princess 2nd	Ashfield Prometheus	J.2	273	7,048	4·8	343
Sunny Glen Vera 3rd	Ivy Bank Lad	S.3	273	7,871	4·8	382
†Glen Erin Madeira	Ashfield Prometheus	S.2	273	6,485	6·5	423
†Glen Erin Madeira	Ashfield Prometheus	S.2	305	6,997	6·5	459

TABLE 11—*continued.*

RECORDS OF COWS COMPLETING LACTATION RECORDS DURING THE YEAR ENDED 30TH JUNE, 1950—*continued.*

Cow.	Sire.	Age.	Days Recorded.	Production. Milk.	Test.	Butterfat.
				Lb.	%	Lb.
	McLENNAN, T., Willowvale (A.I.S., 3).					
†Murcott Laurel 3rd	Fairthorn Rainbow's Prince	J.2	273	10,122	3·4	348
†Murcott Clara 6th	Fairthorn Rainbow's Prince	J.2	273	6,016	3·9	238
Murcott Petunia 4th	Fairthorn Rainbow's Prince	J.2	273	5,681	3·1	179
	MILLER, G., Chambers Flat (Guernsey, 1).					
†Oakwood Fay	Fairfield Winner	J.4	273	6,829	4·6	317
	MITCHELL AND MULCAHY, S., Warwick (A.I.S., 2).					
†Fairlie Princess 38th	Fairlie Credence 2nd	Mature	273	10,001	4·3	432
Fairlie Cherry 21st	Corunna Potentate	S.3	273	8,753	3·7	325
	MOLLER, H. F., Boonah (A.I.S., 3).					
†Springleigh Buttercup 32nd	Blacklands Melba's Pride	S.4	273	8,045	4·6	370
†Springleigh Mavis 8th	Blacklands Melba's Pride	S.2	273	7,189	4·3	315
†Springleigh Buttercup 45th	Blacklands Rob Roy	S.2	273	6,494	4·5	293
	MOORE, S. R., Wooroolin (A.I.S., 1).					
†Sunnyside Mabel 25th	Sunnyside Moneymaker	J.2	273	6,389	3·6	233
	MURDOCH J., AND WRIGLEY, M. J., Preston (Guernsey, 4).					
†Evermore Josie	Yarraview Commander	Mature	273	5,834	6·1	361
†Evermore Merle	Yarraview Commander	S.3	273	4,700	6·7	317
†Evermore Tess	Yarraview Commander	Mature	273	6,054	6·3	387
†Evermore Maytime	Yarraview Commander	Mature	273	5,738	6·5	376
	NAUMANN, C. H., Yarraman (Friesian, 3).					
†St. Athans Piebe Annette 2nd	Greenvale Segis Piebe 3rd	Mature	273	15,984	3·1	506
†Yarrabine Dell	St. Athans Belle Piebe 3rd	J.2	273	6,556	3·5	233
Rockview Beauty	Burnbrae Pontiac Piebe	S.4	273	9,089	3·4	318

NEWTON, E. C., Caboolture (Jersey), 3.						
Malvern Empress	Grasmere Gambogia's Royal	S.2	273	3,935	5·7	225
Merry Vale Golden Girl	Trinity Royal Golden	J.2	273	4,365	5·0	222
Boree Cute Peeress	Trinity Cute Commodore	Mature	273	5,249	5·2	274
NORGAARD, L., AND N., Nara (Ayrshire, 2).						
Myola Jollity 8th	Myola Bonnie Duke	Mature	273	8,921	4·1	370
Holm Park Lady Bird 3rd	Myola Bonnie Duke	Mature	273	8,951	4·1	369
NUGENT, V. R., Murgon (A.I.S., 1).						
†Rhodesview Nancy 75th	Fairvale Major	J.3	273	8,476	3·7	316
O'CONNOR BROS., Colinton (A.I.S., 6).						
†Ronnoc Calm 5th	Ronnoc General	J.2	273	4,914	4·8	237
†Ronnoc Mermaid 3rd	Ronnoc Emblem	Mature	273	10,191	3·7	379
†Meadowvale Gold 31st	Parkdene Major	J.2	273	6,552	4·1	274
†Ronnoc Calm 3rd	Ronnoc Emblem	J.3	273	7,082	4·2	300
†*Ronnoc Clyde 2nd	Ronnoc Emblem	Mature	253	10,244	4·3	441
†Ronnoc Lady May 5th	Ronnoc Emblem	Mature	251	8,793	4·0	352
O'SULLIVAN, C., Greenmount (A.I.S., 8).						
†Navillus Plum 7th	Greyleigh Eros	J.4	273	8,130	4·1	337
†*Navillus Showgirl 4th	Greyleigh Eros	Mature	273	19,322	3·6	709
†Navillus Countess 5th	Parkview Limerick	S.3	239	11,728	3·9	465
†Navillus Carnival's Plum 8th	Navillus Carnival	J.2	273	6,971	4·3	300
†Navillus Showgirl 5th	Parkview Limerick	J.4	273	15,034	3·6	552
*Navillus Charm 17th	Greyleigh Eros	Mature	273	15,229	4·0	617
Navillus Marigold	Blacklands Candidate	J.2	273	9,322	3·9	368
Navillus Charm 21st	Blacklands Candidate	J.2	273	5,466	5·0	278
PICKELS. A., Proston (A.I.S., 10).						
†Blacklands Foremost 44th	Blacklands Gloucester	S.2	273	11,310	3·9	451
†Blacklands Miss Jean 24th	Blacklands Gloucester	J.2	273	8,289	3·6	301
†Blacklands Joan 12th	Blacklands Gloucestor	J.2	273	6,794	4·6	318
†Blacklands Lady Jean 30th	Blacklands Maiden's Monarch	S.2	273	8,796	3·4	303
†Blacklands Ethel 37th	Blacklands Gloucester	S.2	273	6,977	3·5	250
†Blacklands Ethel 32nd	Blacklands Maiden's Monarch	J.4	273	9,261	4·1	384
†Blacklands Carnation 17th	Blacklands Gloucester	S.2	273	6,723	4·0	270
†Blacklands Buttercup 17th	Parkview Alexander	J.2	273	8,558	3·6	311
†Blacklands Ettie 19th	Parkview Viceroy	Mature	273	10,189	3·7	387
†Blacklands Maiden 20th	Blacklands Topsy's Elect	J.2	273	7,044	3·6	256

TABLE 11—*continued.*

RECORDS OF COWS COMPLETING LACTATION RECORDS DURING THE YEAR ENDED 30TH JUNE, 1950—*continued.*

Cow.	Sire.	Age.	Days Recorded.	Production. Milk.	Test.	Butterfat.
				Lb.		Lb.
	PORTER, F., Cambroon (Jersey, 19).					
†Westwood Majesty	Trecarne Golden King 2nd	S.2	273	6,464	6·8	442
†Westwood Waratah	Glenview Lochiel	J.2	273	7,093	5·5	397
†Westwood Silver Leaf	Devon Park Madeira's Victorious	J.2	273	5,493	5·3	292
†Westwood Courtship	Devon Park Madeira's Victorious	J.2	273	5,549	5·5	310
†Westwood Nita	Devon Park Madeira's Victorious	J.2	273	4,447	6·2	276
Westwood Genoese	Devon Park Madeira's Victorious	S.2	273	6,415	6·0	387
Westwood Leonie	Trecarne Golden King 2nd	J.4	273	6,027	6·2	374
Westwood Skyway	Trecarne Golden King 2nd	S.3	273	6,608	5·7	383
Westwood Tea Gown	Devon Park Madeira's Victorious	S.2	273	5,869	6·1	363
Westwood Brenda	Devon Park Madeira's Victorious	S.2	273	5,445	6·0	328
Westwood Patience	Devon Park Madeira's Victorious	J.2	273	6,718	5·6	381
Westwood Daydawn	Devon Park Madeira's Victorious	J.2	273	5,923	6·1	366
Westwood Delhi	Devon Park Madeira's Victorious	J.2	273	5,761	5·6	325
Westwood Royal Court	Devon Park Madeira's Victorious	J.2	273	4,970	6·0	299
Westwood Valaire	Devon Park Madeira's Victorious	J.2	273	5,259	5·5	293
Westwood Florian	Devon Park Madeira's Victorious	J.2	273	4,441	5·5	245
Westwood Lyre Bird	Devon Park Madeira's Victorious	S.2	273	5,083	5·4	276
Westwood Venus	Devon Park Madeira's Victorious	J.2	273	4,300	6·6	285
Westwood Silverstar	Devon Park Madeira's Victorious	J.2	273	4,117	5·8	241
	POWELL, A. E., Chinchilla (A.I.S., 3).					
†Corella Dulcie	Alfa Vale Jumbo	S.2	273	7,233	3·7	270
†Bunyaview Queenie	Trevor Hill Progress	S.2	273	9,037	3·5	321
†Cloverdale Dove 2nd	Haroldale Barrister	S.2	273	8,227	3·6	298
	POWER, M., Kapaldo (A.I.S., 2).					
Blacklands Pretty Jean 14th	Blacklands Czar	S.3	273	7,515	4·1	313
Wattleview Agatha 2nd	Blacklands Elected	Mature	273	11,405	4·1	477

Q.A.H.S. AND COLLEGE, Lawes (A.I.S., 15).

†College Rapture 3rd	Sunnyview Alert	Mature	273	10,141	3·8	389
†College Kitty 11th	Alfa Vale Pride 3rd	J.3	273	7,224	3·8	277
†College Rapture 9th	Alfa Vale Magic	S.2	273	8,303	3·5	292
†College Rascal 19th	Alfa Vale Pride 3rd	J.3	273	6,897	4·0	279
†College Stately 25th	Alfa Vale Pride 3rd	S.2	273	8,116	3·3	271
†College Rapture 10th	Alfa Vale Pride 3rd	S.2	273	7,453	3·6	269
†College Dizzy 2nd	Alfa Vale Pride 3rd	J.2	273	6,340	4·5	287
Bingleigh Ettie 12th	Trevlac Gentle Prince	J.3	273	8,146	3·6	299
Bingleigh Fanny 3rd	Trevlac Gentle Prince	S.2	273	5,934	4·1	244
†Ennismore Emma 3rd	Arolla Limerick	S.2	273	5,842	4·2	251
Bingleigh Ettie 14th	Trevlac Gentle Prince	J.2	273	4,773	3·8	185
Kinross Diamond 17th	Railway View Premier	Mature	273	9,260	3·1	296
Bingleigh Miss Jean 8th	Blacklands Jean's Victory	S.2	240	4,479	4·0	179
Millievale Olive 2nd	The Coral Gold Standard	S.2	180	3,126	3·5	112
College Stately 27th	Alfa Vale Pride 3rd	S.2	210	1,698	4·4	76

Q.A.H.S. AND COLLEGE, Lawes (Jersey, 16).

†Grasmere Victorious Camille	Navua Victorious Samaritan	J.3	273	5,628	4·8	274
†Carnation Princess June	Oxford Fawn's Victor	J.2	273	6,934	5·5	383
†Carnation Cream Girl	Oxford Fawn's Victor	J.2	273	5,907	5·9	354
†College Florette 11th	Westbrook Ambassador 52nd	J.2	273	5,900	4·5	267
†Glenside Dalice	Oxford Dudley	J.2	273	5,153	5·0	263
†Glenside Goldenia	Oxford Dudley	J.2	273	5,005	5·1	260
†Oxford Louella	Oxford Franklin	J.2	273	4,301	5·4	232
†O.K. Palatine Florence	Lobelia Palatine Sultan	Mature	252	6,623	5·5	371
†Glenside Ivy 2nd	Oxford Dudley	J.2	273	4,997	6·0	302
†Carnation Felicity	Oxford Fawn's Victor	S.2	273	7,172	5·0	360
†College Fleur 7th	Westbrook Ambassador 52nd	S.2	273	6,094	4·4	272
Grasmere Sam's Queen	Navua Victorious Samaritan	J.2	273	5,087	5·7	293
†College Treasure	College Stalwart 4th	J.2	273	4,406	5·8	258
Grasmere Victorious Rochette	Navua Victorious Samaritan	Mature	273	6,436	5·3	353
Blaxland Franchipaleen	O.K. Palatine Majestic	J.4	273	6,961	5·0	351
Oxford Lady Marion	Oxford Franklyn	J.3	273	5,808	5·1	300

RALPH, G., Ravensbourne (Jersey, 5).

†Ashview Queen 4th	Trecarne Victor 4th	J.2	273	5,592	4·5	256
Silverbrook Primrose 2nd	Trinity Noble Effort	J.2	273	5,141	4·7	245
Silverbrook Shamrock 2nd	Trinity Noble Effort	J.2	273	4,466	4·7	214
Ashview Hopeful 2nd	Trecarne Some Tot's Duke 2nd	J.2	273	3,725	5·4	203
Silverbrook Joyful 2nd	Trinity Noble Effort	J.2	273	3,605	5·2	188

TABLE 11—*continued.*

RECORDS OF COWS COMPLETING LACTATION RECORDS DURING THE YEAR ENDED 30TH JUNE, 1950—*continued.*

Cow.	Sire.	Age.	Days Recorded.	Production.		
				Milk.	Test.	Butterfat.
				Lb.	%	Lb.
RUGE BROS., Woowoonga (Guernsey, 6).						
Springvale Curly	Moongi Lloyd George	S.2	273	7,533	4·5	340
†Springvale Jennifer	Moongi Gay Sport	S.2	273	7,453	3·9	291
†Willowbrae Daffodil	Linwood Pharos	J.2	273	7,157	4·7	336
†Springvale Jessie	Moongi Lloyd George	J.2	273	6,991	4·0	285
†Springvale Orange	Moongi Lloyd George	J.2	273	5,922	4·5	270
†Springvale Fanny	Moongi Lloyd George	S.2	273	7,478	4·7	354
RUHLE, J. P., Motley (Ayrshire, 8).						
†Leafmore Phyllis 2nd	St. Christopher's Hazel Boy	J.2	273	6,563	3·9	257
†Leafmore Hedley	St. Christopher's Hazel Boy	J.2	242	5,461	4·3	235
†Leafmore Lady Vee	Myola Jaunt 2nd	J.2	273	5,838	4·1	242
†Leafmore Bonnie's Queen	Leafmore Jerrard	S.3	273	6,872	4·3	296
†Leafmore Vestage	Myola Perfection	J.2	273	5,982	4·5	273
†Leafmore Handsome 2nd	Myola Perfection	J.2	273	6,154	4·2	262
†Leafmore Harriet 4th	Myola Perfection	J.2	273	5,604	4·4	250
†Leafmore Lady Vynne	Myola Perfection	J.2	273	5,252	4·5	239
RUHLE, K. A., Motley (A.I.S., 5).						
†Trevor Hill Rosalyn	Fairvale Jellicoe	J.2	273	9,357	4·8	450
†Corunna Isabel	Fairvale Duncan	S.4	239	9,007	4·3	388
†Fairvale Dulcie 10th	Fairvale Dairy Lad	S.2	273	6,374	4·4	285
†Yarranvale Joyful	Yarranvale Prospector	S.3	243	11,492	3·4	506
†Yarranvale Dolly	Fairvale Viceroy	S.2	249	5,921	5·1	306
SANDERSON, H., Monto (Guernsey, 2).						
†Adaville Olwyn	Fernhill Rose Boy	Mature	273	7,477	5·2	391
†O. Kay Hollyhock	Linwood Goldfinder	J.3	273	6,261	4·9	312

	SANDERSON, W., Mulgeldie (A.I.S., 3).					
Sunlit Farm Ita 13th	Sunlit Farm Madam's Victory	S.2	273	7,842	3·7	293
Hillfield Sarah 2nd	Blacklands Florrie's 9th Heir	J.2	273	6,698	4·0	268
Hillfield Jean 2nd	Bingleigh Jean's Emperor	J.2	273	6,068	4·3	264
	SANDILANDS, A., Wildash (A.I.S., 2).					
†Penrhos Pansy 23rd	Rosenthal McArthur	S.2	273	6,841	3·8	265
†Penrhos Sally 4th	Rosenthal McArthur	J.3	273	6,886	4·4	308
	SCHULL, J. and SONS, Oakey (Jersey, 9).					
†Lermont Golden Kate 2nd	Trinity Graceful Duke	J.3	273	4,588	6·3	291
†Silverbrook Belarine	Trinity Graceful Duke	J.2	273	5,351	5·7	305
†Lermont Connie	Trinity Graceful Duke	S.2	273	5,076	5·5	280
†Lermont Gentle 4th	Trinity Graceful Duke	S.2	273	4,309	6·1	263
†Lermont Brightgirl	Selsey Samares Hallmark	Mature	273	5,493	6·3	351
†Silverbrook Mable 2nd	Trinity Noble Effort	S.2	273	5,248	5·3	279
†Lermont Pride	Trinity Graceful Duke	J.3	273	6,050	5·3	326
†Silverbrook Carnation	Trinity Noble Effort	J.2	273	5,897	4·9	290
†Lermont Madeira 4th	Trinity Graceful Duke	J.2	273	5,152	5·3	275
	SCOTT, J. N., Camp Mountain (Ayrshire, 3).					
†Auchen Eden Bessie	Oatlands Duke	J.2	273	5,867	4·1	245
Auchen Eden Bella Donna	Oatlands Duke	S.3	273	6,108	4·3	265
Auchen Eden Titania	Oatlands Duke	J.3	273	6,893	4·3	302
	SCOTT, W. and A. G., Blackbutt (A.I.S., 3).					
†Aynesley Rosy 4th	Alfa Vale Pride 6th	Mature	273	12,014	3·8	467
†Aynesley Bud 7th	Newstead Chancellor	J.4	273	8,973	3·8	345
†Aynesley Gwen 12th	Valera Daphne's Pride 3rd	S.2	273	6,648	3·8	253
	SEMGREEN, A. L., Coolabunia (Jersey, 11).					
†Tecoma Myrtle	Austral Park Double Blue	J.2	273	5,934	5·5	329
†Tecoma Averiel	Glenview Royal Chief	J.3	273	5,004	5·5	278
†Tecoma Blue Columbine	Austral Park Double Blue	S.2	273	5,765	5·0	292
†Tecoma Success	Austral Park Double Blue	S.2	273	8,588	4·2	361
†Tecoma Success	Austral Park Double Blue	S.2	365	10,948	4·2	462
Tecoma Madam	Tecoma Prince Clair	Mature	273	7,281	5·5	402
†Tecoma Golden Darling	Trinity Golden Royal	Mature	273	6,504	6·0	395
†Tecoma Fairy Dove	Trinity Golden Royal	Mature	273	7,907	4·7	375
Tecoma Blue Pet	Austral Park Double Blue	S.2	273	5,415	6·3	342
Austral Park Coronation Cowslip	Austral Park Coronation Oxford	Mature	273	9,619	5·2	503
Tecoma Golden Opportunity	Trinity Golden Royal	J.2	273	7,421	4·7	351
Tecoma Golden Princess	Trinity Golden Royal	J.3	273	7,673	5·5	424

TABLE 11—*continued.*

RECORDS OF COWS COMPLETING LACTATION RECORDS DURING THE YEAR ENDED 30TH JUNE, 1950—*continued.*

Cow.	Sire.	Age.	Days Recorded.	Production. Milk.	Test.	Butterfat.
				Lb.	%	Lb.
	SHELTON, R. A. and N. K., Hivesville (A.I.S., 1).					
†Highfields Ethel 4th	Berry Trenton	Mature	273	13,032	3·5	467
	SIGLEY, H., Jaggan (Jersey, 7).					
†Myrtledale Duchess	Palm Ridges Golden Victory	J.2	273	4,877	6·0	294
†Palmridges Sylvina	Overlook Financier	Mature	255	9,984	5·1	515
†Myrtledale Sweet Marie	Palm Ridges Golden Victory	S.2	244	6,257	5·7	361
†Myrtledale Ina	Oxford Remus Count	J.4	273	6,816	5·7	393
Palm Ridges Leti	Palm Ridges Mike	S.4	273	5,614	5·4	307
Palm Ridges Pam	Oxford Leander	Mature	273	7,714	5·1	395
Myrtledale Medal	Myrtledale Royal Leader	J.2	273	5,387	5·6	303
	SKERMAN, I. B., Kaimkillenbun (A.I.S., 6).					
†Rippley Park Mossrose 4th	Glenroy Security	J.3	273	6,748	4·0	271
†Fairvale Dulcie 8th	Fairvale Red Prince	J.3	273	6,119	4·5	277
†Faversham Gideon's Ruby	Girraween Gideon	J.2	273	4,695	4·9	234
†Rippley Park Sweet Brier	Trevor Hill Reflection	J.2	273	6,854	3·9	272
Faversham Gem 7th	Croydon Marchese	S.4	273	5,799	4·3	254
Moola Rose	Navillus Vera 3rd's Renell	S.3	273	7,034	4·0	288
	SPERLING, G., Kooralgin (A.I.S., 4).					
†Blacklands Envy 48th	Blacklands Topsy's Elect	S.2	273	6,021	4·1	252
†Bunya View Thelma 5th	Trevor Hill Perfection	Mature	273	9,179	3·9	363
Highfields Connie 7th	Laguna Emblem	S.3	273	5,548	3·2	183
Chelmer Star 4th	Blacklands Defender	J.2	273	5,389	4·5	243
	SPRESSER AND SONS, W., Rosewood (Jersey, 1).					
†Carnation Barbara	Oxford Fawn's Victor	S.2	273	4,837	5·1	251

	STIMPSONS LTD., Loganlea (Ayrshire, 12).					
†Eleresley Fay 2nd	Auchen Eden Miracle	J.3	273	7,613	3·9	297
†Eleresley Mamie 4th	Oatlands Q. Dan	S.2	273	7,449	3·7	281
†Eleresley Cynthia 2nd	Auchen Eden Miracle	J.2	273	6,461	4·2	275
†Eleresley Gay Girl 2nd	Oatlands Q. Dan	J.3	273	8,303	4·0	340
†Eleresley Josephine	Benbecula Banker	Mature	273	10,592	4·1	437
Eleresley Jonquil	Eleresley Major 2nd	Mature	273	10,745	4·1	448
Eleresley Robina	Benbecula Banker	Mature	273	10,656	3·9	417
*Eleresley Francis	Benbecula Banker	Mature	273	8,461	3·8	330
Alanbank Gay Bell	Auchen Eden Gay Laddie	S.2	273	5,978	3·8	232
Alanbank Carol	Alanbank Fancy Boy	J.3	273	6,633	4·2	280
Eleresley Sun 3rd	Auchen Eden Miracle	J.3	273	7,634	3·9	303
Eleresley Margaret	Oatlands Q. Dan	S.2	273	6,231	4·3	274
	ST. CHRISTOPHER'S LODGE, Brookfield (Ayrshire, 4).					
Leafmore Loretta	Myola Jellicoe	Mature	273	6,646	4·0	267
St. Christopher's Olive	St. Christopher's Angel Boy	J.2	273	6,306	3·9	247
Myola Olive 3rd	Myola Jellicoe	Mature	273	6,867	3·8	263
St. Christopher's Vinnie 2nd	Myola Perfection	S.4	273	6,788	3·7	253
	SULLIVAN, ESTATE M. T., Beaudesert (A.I.S. and Dairy Shorthorn, 4).					
Millside Beauty 7th	Hillfield Barrinton	S.4	210	4,020	3·4	138
Millside Daisy 7th	Morven Lord Cressida 41st	J.3	273	5,394	3·6	195
Yarrowee Margaret	Morven Lord Cressida 41st	S.2	240	3,903	3·9	156
Burnslands Dainty (A.I.S.)	Fairvale Dainty's Pride	J.4	273	8,633	4·0	350
	SULLIVAN, D., Pittsworth (A.I.S., 7).					
†Bantry Lila	Rosenthal Surplus 2nd	J.3	273	8,763	4·4	393
†Bantry Model 2nd	Valera Monarch	S.2	273	7,554	5·3	321
†Bantry Nellie 2nd	Rosenthal Surplus 2nd	S.3	273	8,808	3·9	347
†Bantry Model 3rd	Bantry Commodore	J.2	273	6,415	4·0	263
Bantry Nellie 4th	Bantry Commodore	J.2	273	10,607	3·8	411
Bantry Rose 3rd	Rosenthal Surplus 2nd	S.3	273	6,488	4·1	267
Bantry Bonny 3rd	Bantry Commodore	J.2	273	7,709	3·9	303
	SULLIVAN, F. B., Pittsworth (A.I.S., 6).					
†Fermanagh Lila 4th	Valera Daphne's Prince	J.2	207	5,452	4·4	241
*Valera Lila 13th	Alfa Vale Pride 2nd	Mature	273	9,308	4·1	387
Valera Chance 2nd	Valera Daphne's Pride 2nd	Mature	210	6,585	3·9	259
*Fermanagh Chance	Alfa Vale Pride 2nd	J.4	273	8,282	4·4	368
*Fermanagh Lila 4th	Valera Daphne's Prince	J.3	240	6,243	4·4	281
Valera Pride's Roseleaf 2nd	Alfa Vale Pride 2nd	S.4	273	9,790	4·0	399

TABLE 11—*continued.*

RECORD OF COWS COMPLETING LACTATION RECORDS DURING THE YEAR ENDED 30TH JUNE, 1950—*continued.*

Cow.	Sire.	Age.	Days Recorded.	Production. Milk.	Test.	Butterfat.
				Lb.	%	Lb.
SULLIVAN BROS., Pittsworth (A.I.S., 8).						
†Valera Roseleaf 29th	Valera Monarch	J.2	242	6,514	4·2	280
†Valera Bonny 14th	Alfa Vale Pride 2nd	S.2	273	9,222	4·1	383
†Valera Dahlia	Alfa Vale Pride 2nd	S.2	273	6,562	4·4	294
Valera Lila 21st	Valera Monarch	J.3	240	7,164	3·9	284
Valera Roseleaf 28th	Alfa Vale Pride 2nd	J.3	180	4,164	4·3	180
Valera Judy 2nd	Valera Monarch	J.2	273	9,726	3·9	387
*Valera Roseleaf 16th	Alfa Vale Pride 2nd	Mature	273	16,745	4·2	716
*Valera Sally 7th	Alfa Vale Pride 2nd	S.2	273	10,613	4·2	451
TATNELL, W., Gympie (Jersey, 9).						
Golden Vale Gwendoline	Westbrook Aster's Lad 44th	Mature	273	2,464	5·1	127
Golden Vale Tourmaline	Westbrook Aster's Lad 44th	Mature	273	4,301	5·0	217
Golden Vale Buttercup	Westbrook Aster's Lad 44th	S.4	273	4,067	4·8	199
Golden Vale Carnation	Westbrook Aster's Lad 44th	Mature	273	5,579	5·5	307
Golden Vale Janice	Westbrook Aster's Lad 44th	Mature	273	5,496	4·9	275
Golden Vale Charlotte	Westbrook Aster's Lad 44th	Mature	273	3,360	5·2	177
Golden Vale Rosey	Westbrook Aster's Lad 44th	S.4	273	4,380	5·4	237
Golden Vale Enid	Westbrook Aster's Lad 44th	S.4	273	4,383	5·2	231
Golden Vale Dawn	Westbrook Aster's Lad 44th	S.4	273	3,453	4·5	159
THEUERKAUF, H., Dundas (Jersey, 4).						
Oxford Midge	Oxford Franklyn	S.2	273	8,014	4·4	396
Pinegrove Pearl	Glenview Victory	S.2	273	5,534	5·1	284
Pinegrove Mandoline	Glenview Victory	J.2	273	2,230	5·4	122
Oxford Gracious	Oxford Ajax	Mature	273	8,357	5·5	463

THOMPSON, W., Nanango (A.I.S., 7).						
†Alfa Vale Model 29th	Alfa Vale Paisley	J.3	349	17,636	4·8	847
†Alfa Vale Pet 5th	Penrhos Pansy's Pride	J.2	273	7,995	4·0	325
†Alfa Vale Model 27th	Alfa Vale Stalin	Mature	273	8,908	4·5	406
†Alfa Vale Florrie 7th	Penrhos Pansy's Pride	J.3	273	8,297	4·5	380
†Alfa Vale Myrtle 6th	Alfa Vale Reward 2nd	J.3	273	8,312	4·0	334
†Alfa Vale Eveline 11th	Alfa Vale Stalin	Mature	273	8,589	4·3	377
†Alfa Vale Gentle 11th	Alfa Vale Pat	Mature	273	11,327	4·9	559
THORNTON, H. A., Kilcoy (Jersey, 5).						
Bellmore Shirley's Queen	Glenview Explorer	Mature	273	4,374	5·1	225
Trinity National Poppy	Trinity National Victory	J.4	273	8,263	4·7	390
Trinity Golden Cowslip	Trinity National Victory	S.3	273	7,846	4·6	364
Bellmore Mariette	Glenview Standard	S.2	273	5,237	5·1	272
Trinity Mountain Fairy	Trinity Crowning Effort	J.2	273	4,885	5·1	250
TRIGGER, A. E., Didcot (Jersey, 2).						
†Burnlea Matilda	Woodside Rochette's Monarch	J.4	273	6,038	5·3	325
†Burnlea Matilda 2nd	Yuruga Golden Noble	J.2	273	4,970	5·0	253
TUDOR, W. and C. E., Branch Creek (Jersey, 3).						
†Boree Cute Peggy	Trinity Cute Commodore	J.2	273	7,914	5·0	397
†Boree Cute Charming	Trinity Cute Commodore	S.2	273	7,003	5·4	380
Boree Effort's Dahlia	Trinity Daffodil's Effort	S.3	273	9,478	4·6	443
TURNER, H. A., Tarzali (A.I.S., 5).						
†Dorravista Floss	Evansvale Eclipse	Mature	273	15,313	4·9	752
†Dorravista Model	Glengarriffe Peter	Mature	273	11,271	4·0	458
†Dorravista Beauty	Evansvale Eclipse	Mature	273	11,304	4·4	503
†Dorravista Dot	Learmont Byron	S.3	231	6,973	4·6	327
†Dorravista Annie 5th	Learmont Byron	S.3	234	6,826	4·6	315
VAYRO, T., Helidon (A.I.S., 3).						
†Sydmouth Blossom 2nd	Navillus Paros	S.3	273	9,638	3·7	358
†Sydmouth Blossom	Navillus Paros	J.4	273	8,918	3·8	347
†Sydmouth Una 2nd	Navillus Paros	S.2	273	6,943	4·2	292

TABLE 11—*continued.*

RECORDS OF COWS COMPLETING LACTATION RECORDS DURING THE YEAR ENDED 30TH JUNE, 1950—*continued.*

Cow.	Sire.	Age.	Days Recorded.	Production. Milk.	Test.	Butterfat.
				Lb.	%	Lb.
	WADLEY, D., Indooroopilly (Jersey, 8).					
†Trinity Effort's Lady	Trinity Crowning Effort	Mature	273	8,664	4·6	400
†Glenbrook Golden Lynn	Lrrmont Golden Victory	Mature	273	7,327	5·2	381
†Trinity Cute Lady 2nd	Trinity Cute Effort	S.2	273	6,216	4·5	286
†Trinity Prim Lass	Tiinity Crowning Effort	J.3	273	5,929	5·3	316
Nindethana Ila	Trinity Valiant Effort	J.3	273	5,760	5·3	310
Trinity Victory Belle	Tiinity National Victory	J.2	273	6,348	5·2	336
Trinity Royal Barleycorn	Trinity National Victory	J.2	273	5,428	5·0	272
Nindethana Crescent	Trinity Valiant Effort	J.2	273	5,225	4·7	248
	WALTERS, F. W., Booyal (A.I.S., 3).					
Vermont Cherry 6th	Chelmer Diamond Lad	S.4	180	4,545	3·6	164
Happy Valley Buddy 4th	Newstead Ludlow	J.2	273	4,753	3·8	182
Happy Valley Honeycombe	Sunnyview Premium	J.2	273	6,222	3·8	239
	WATSON, H. G., Killarney (A.I.S., 2).					
†Wenlock Beauty 5th	Parkview Limerick	J.2	273	6,099	4·3	263
†Wenlock Merle	Parkview Limerick	J.2	273	6,058	4·0	247
	WEBB, R. W., Nanango (Jersey, 1).					
†Benvue Betty	Navua Royalist Prince	S.2	273	6,988	4·8	336
	WEBSTER, A. H., Helidon (A.I.S., 7).					
†Millievale Doris	The Coral Gold Standard	S.2	273	7,003	3·9	274
†Millievale Charlotte 2nd	The Coral Gold Standard	S.2	273	10,066	4·1	418
†Millievale Cora 4th	Alfa Vale Pride	J.2	273	7,092	3·8	275
†Millievale Maggie 2nd	The Coral Gold Standard	J.3	273	9,213	3·4	320
†Millievale Handsome 2nd	Oakey Vale Playboy	S.2	273	7,526	3·8	289
†Millievale Silver 2nd	Oakey Vale Playboy	S.2	273	6,985	3·6	256
†Millievale Locket	Oakey Vale Playboy	S.2	273	6,466	3·9	255

WHITE, W. A., Malanda (Jersey, 1).						
†Coraldale Pretty Maid	Peeramon Britain	J.2	273	4,268	5·6	241
WILTON, J., Killarney (Jersey, 4).						
†Romsey Stylish Hope	Bellgarth Stylish	Mature	273	7,614	5·2	400
†Romsey Brown Lady	Oxford Flying Fox	J.2	273	5,189	5·5	286
†Romsey White Rose	Oxford Flying Fox	J.2	273	5,252	5·1	271
†Romsey Larkspur's Pride	Oxford Flying Fox	J.2	273	5,086	5·1	261
WOODFORD, A. P., Kapaldo (A.I.S., 2).						
Eureka Rosebud	Cedargrove Saturn	Mature	273	11,360	4·1	467
Applegarth Joyful Maid 4th	Blacklands Czar	Mature	273	11,672	3·8	445
YOULES, R. J. E., Kilcoy (A.I.S., 3).						
Mordern Sadie 22nd	Fairvale Red Prince	S.2	273	6,911	4·2	293
Happy Hill Red	Euroa Sceptre	S.2	240	4,071	4·6	188
*Bingleigh Molly 16th	Blacklands Emblem	J.4	210	6,372	3·5	229

TABLE 12.

AVERAGE PRODUCTION OF DAUGHTERS OF INDIVIDUAL SIRES.

Reference No.	Sire.	Herd Book No.	Average Production of Daughters in Various Age Groups.												Average of all Recorded Daughters.				
			2 Year Old.			3 Year Old.			4 Year Old.			Mature.							
			No.	Milk.	Butter-fat.	No.	Milk.	Butter-fat.	No.	Milk.	Butter-fat.	No.	Milk.	Butter-fat.	No.	No. Lact	Milk.	Test.	Butter-fat.
				Lb.	Lb.		Lb.	Lb.		Lb.	Lb.		Lb.	Lb.			Lb.	%	Lb.
	A.I.S.																		
1	Alfa Vale Nigel	6,439	9	7,176	291	7	7,450	302	2	8,137	307	1	11,674	445	16	19	7,410	3·99	296
2	Alfa Vale Plumber	1,345	3	7,185	294	4	6,727	283	4	8,135	345	5	8,501	341	16	16	7,844	4·07	319
3	Alfa Vale Pride 2nd	5,441	24	7,598	319	8	8,507	362	4	7,486	313	3	12,301	527	32	43	7,747	4·26	330
4	Alfa Vale Pride 3rd	4,515	14	6,398	268	6	6,400	267	2	6,680	300	..	..	..	21	22	6,247	4·34	271
5	Alfa Vale Re-Nell	384	12	6,945	272	10	8,022	317	5	7,690	302	3	10,692	434	24	29	7,495	3·96	297
6	Bingleigh Jean's Monarch	6,579	5	8,160	388	6	8,060	412	1	5,962	217	2	13,361	496	10	14	8,874	4·33	384
7	Bingleigh Royal	6,582	3	6,574	268	3	8,321	322	5	7,252	282	1	10,583	448	10	12	7,213	3·91	282
8	Blacklands Count	3,724	17	7,266	293	9	8,624	339	2	10,047	398	3	12,496	512	26	31	8,144	4·01	327
9	Blacklands Czar	3,045	5	6,327	266	4	7,745	315	4	8,930	344	3	9,466	362	15	16	8,021	4·13	331
10	Blacklands Emblem	4,592	11	8,021	332	1	9,797	388	1	6,372	229	..	..	..	13	13	8,031	4·01	328
11	Blacklands Jeans Victory	5,528	8	7,450	318	2	7,341	296	..	..	..	..	..	..	10	10	7,500	4·20	315
12	Blacklands Prospector	37	30	7,743	302	12	8,325	317	1	7,552	324	8	11,302	466	45	54	8,238	3·91	322
13	Burradale Byron	1,258	10	10,161	389	2	14,041	514	1	9,025	367	1	10,980	403	14	14	10,693	3·45	369
14	Corunna Supreme	3,118	19	7,004	275	6	8,620	334	4	9,911	414	5	9,913	411	27	35	7,837	4·08	320
15	Dnalwon Count	2,016	7	6,026	225	3	7,847	282	2	8,342	311	2	8,917	312	13	14	7,095	3·66	260
16	Dnalwon Felix	5,639	6	7,060	249	3	8,196	283	1	8,967	284	2	10,184	367	10	13	7,864	3·60	283
17	Dulcamah Disraeli	3,150	9	5,514	231	1	8,003	326	3	7,281	321	4	8,824	354	13	17	6,501	4·20	273
18	Fairholme Lewis	6,825	10	6,247	284	1	7,233	334	..	..	..	..	..	..	11	11	6,337	4·54	288
19	Fairthorn Rainbows Prince	6,834	12	6,566	248	1	4,518	166	..	..	..	..	..	..	13	13	6,408	3·78	242
20	Fairvale Ensign	5,716	..	..	..	3	9,606	365	2	9,078	346	5	8,424	330	10	10	8,909	3·86	344
21	Fairvale Jellicoe	8,082	10	7,469	334	..	..	..	1	9,563	390	..	..	..	11	12	7,659	4·43	339
22	Fairvale Major	4,816	8	7,106	300	6	7,758	311	6	7,519	322	9	9,571	416	23	33	7,960	4·25	338
23	Glengallon Major	1,551	6	6,848	280	4	6,674	272	2	7,607	319	2	7,557	308	13	14	7,017	4·13	290
24	Glangarry Gems Royal	4,854	2	7,437	320	5	7,342	345	..	..	..	13	8,082	379	20	21	7,832	4·66	365
25	Greyleigh Eros	2,193	17	6,878	271	7	9,770	391	6	10,542	398	7	12,463	475	25	41	8,446	3·89	329
26	Greyleigh Honorarium	321	3	8,824	275	1	10,246	370	5	9,911	335	6	10,948	383	12	19	9,903	3·31	328
27	Greyleigh Valiant	666	5	9,054	341	9	10,408	403	3	10,035	400	3	9,288	359	19	22	9,676	3·88	375
28	Hillview Premier 2nd	(I.) 1,653	4	6,797	270	7	7,819	314	1	9,131	343	..	..	..	10	12	7,494	3·98	298
29	Kilburnie Royalist	(I.) 3,306	8	6,500	265	5	8,404	292	1	7,072	279	1	7,976	321	13	15	7,372	3·80	280
30	Midget's Sheik of Westbrook	1,511	27	6,972	281	9	8,117	337	1	6,944	319	5	7,853	309	37	45	7,167	4·07	292
31	Murray Bridge Florrie's Prince	(I.) 7,210	4	6,671	273	4	7,631	318	5	8,975	336	1	12,751	520	11	14	8,442	3·97	335
32	Navillus Prince Henry	6,013	5	6,480	320	7	7,304	288	6	8,417	336	5	10,409	399	18	24	7,714	3·94	304
33	Newstead Reliance	5,080	10	7,164	309	9	7,600	319	3	9,021	383	1	9,386	357	20	22	7,578	4·24	321
34	North Glen Emblem	2,522	11	7,491	295	7	8,168	338	5	8,978	354	2	14,604	542	17	28	8,077	4·04	326
35	Parkview Highbrow	6,077	6	6,531	266	2	7,946	328	2	7,861	324	1	10,411	382	10	11	7,161	4·07	292
36	Parkview Limerick	5,110	16	7,288	286	4	10,521	430	2	12,212	450	2	9,658	395	19	25	8,107	3·93	319
37	Patrol of Cosey Camp	1,258(I.)	3	7,218	284	2	6,789	256	3	9,076	355	4	9,954	384	11	14	8,559	3·89	333

38	Penrhos Blossom's Prince	2,577	4	8,265	322	3	6,217	265	2	8,569	334	3	8,207	390	11	13	7,634	4·07	311
39	Penrhos Pansy's Pride	4,265	6	9,809	425	10	11,543	500	3	11,307	492	4	13,994	578	21	24	11,364	4·27	485
40	Penrhos Pansy's Prince	3,455	14	6,693	260	8	5,683	238	..	..	..	5	7,894	325	24	29	6,599	4·00	264
41	Reward of Fairfield	1,769	26	9,270	380	18	11,093	464	12	13,077	552	18	14,188	585	44	89	11,197	4·12	461
42	Ronnoc Emblem	7,409	5	7,099	307	4	6,619	271	5	6,441	264	5	8,232	333	19	20	7,123	4·14	295
43	Rosenthal McArthur	8,461	10	6,190	249	2	5,885	221	..	..	..	..	..	..	12	12	6,139	3·97	244
44	Rosenthal Musketeer	5,214	9	6,764	267	3	7,269	297	1	11,981	503	3	8,726	362	14	18	7,555	4·06	307
45	Rosenthal Pendants Prince	564	18	5,655	225	7	6,540	261	5	7,323	288	8	9,553	410	36	38	6,953	4·07	283
46	Rosenthal Perfection	5,216	7	6,525	261	3	7,519	305	4	8,996	336	6	7,975	347	15	21	7,678	3·97	305
47	Rosenthal Surplus 2nd	683	5	5,727	234	9	8,332	334	1	10,090	415	1	9,369	370	15	16	7,629	4·04	308
48	Rosenthal Surprise	5,222	7	5,893	241	3	7,412	304	..	..	..	1	6,643	342	10	11	6,442	4·02	259
49	Sunlit Farm King Billy	4,376	10	6,743	277	1	7,519	298	1	7,402	289	1	9,903	364	13	13	7,097	4·03	286
50	Sunnyview Artist	3,535	19	5,841	242	2	8,024	333	3	7,667	335	1	8,729	389	22	25	6,278	4·19	263
51	Sunnyview Commodore	2,752	6	9,245	372	4	13,045	557	..	..	..	3	9,408	401	13	13	10,452	4·16	435
52	Sunnyview Kitchener	7,488	5	9,920	418	3	8,701	355	1	9,652	366	1	12,572	519	10	10	9,793	4·12	404
53	Sunnyview Royal National	7,493	8	6,890	273	5	7,988	347	3	9,141	376	..	..	..	15	16	7,430	4·09	304
54	Tabbagong Victory	8,729	11	7,228	291	..	..	..	..	..	..	..	..	..	11	14	7,228	4·03	291
55	Tara Governor	6,297	9	7,046	263	2	9,282	332	1	11,103	378	3	10,570	384	12	15	8,183	3·65	299
55	Travlac General	2,889	14	6,513	253	5	6,286	297	2	8,692	367	..	..	..	20	21	6,535	4·04	265
57	Trevor Hill Bosca	5,351	27	7,332	299	7	8,307	335	8	8,706	349	5	10,181	413	38	47	7,662	4·03	309
58	Trevor Hill Progress	5,353	11	6,386	264	1	7,494	308	..	..	..	..	..	..	12	13	6,479	4·14	268
59	Trevor Hill Reflection	3,583	16	6,852	293	13	7,863	325	6	9,564	402	7	8,221	363	38	42	7,623	4·24	323

AYRSHIRE.

60	Benbecula Marquis	11,670	4	4,639	188	4	7,078	278	3	7,996	316	1	8,870	341	10	12	6,380	3·95	252
61	Benbecula Bonnie Willie	9,479	4	9,193	347	10	8,385	321	1	6,535	292	3	9,491	351	13	17	8,975	3·84	345
62	Myola Bessemer	11,224	10	5,447	214	6	7,278	282	3	5,949	237	1	8,819	371	16	20	6,058	3·83	242
63	Myola Jellicoe	10,568	15	6,107	249	17	6,647	265	8	7,217	394	6	7,193	293	42	50	6,641	4·05	269

GUERNSEY.

64	Fairfield Winner	4,857	4	5,359	250	4	6,948	317	7	6,621	319	..	..	..	13	15	6,453	4·7	303
65	Laureldale Pluto	4,211	1	5,928	285	3	6,001	282	3	5,206	272	4	6,780	344	10	12	6,101	4·95	303
66	Minnamurra Topsey's Sequel 2nd	5,095	11	6,353	330	7	6,959	359	4	9,285	435	3	8,329	422	19	26	6,839	5·03	344
67	Warrawong Winter	4,535	16	6,432	306	9	6,000	299	..	..	..	2	7,467	349	25	27	6,364	4·73	306

JERSEY.

68	Aerofoyle of Banyule	3,181	3	5,794	293	3	6,505	352	2	7,6!6	402	4	8,516	496	10	12	7,003	5·49	385
69	Belgonia Lady Duke	9,513	16	5,580	277	1	5,453	262	3	5,549	293	3	8,170	413	20	23	5,963	5·03	300
70	Belgonia Peggy 9ths Duke	7,429	14	5,114	258	3	6,465	339	1	3,910	207	..	..	..	14	18	5,118	5·10	261
71	Bellgarth Stylish	10,878	13	5,861	328	8	6,081	343	11	6,300	347	12	7,033	395	18	46	6,197	5·55	344
72	Brooklands Regalia	14,490	13	5,255	286	..	..	..	..	..	..	..	..	..	13	15	5,255	5·44	286
73	Bulby Maria Keepsake	16,366 (J.S.B.A.)	11	6,076	307	5	6,314	363	4	7,721	446	3	7,609	403	12	23	6,406	5·25	336
74	Bulby Oxford Gamboge	12,025 (J.S.B.A.)	5	6,601	336	5	7,578	374	3	7,572	387	2	5,982	299	11	16	6,996	4·92	344
75	Burnlea Aviator	8,317	1	5,105	256	7	5,329	258	3	5,870	287	1	6,589	314	10	12	5,523	4·83	267
76	Calton Lothean	9,615	6	6,547	320	4	7,187	377	4	7,328	365	5	7,898	395	13	19	7,177	4·97	357
77	Devon Park Madeiras Victorious	15,744	21	5,490	319	..	..	..	..	..	..	..	..	..	21	21	5,490	5·81	319
78	Glenside Lone Star	9,721	5	6,131	312	1	6,579	327	1	7,860	451	8	8,466	392	12	15	7,338	4·93	362
79	Glenview Royal Chief	13,956	11	5,125	250	2	5,492	272	1	6,498	293	..	..	..	13	14	5,195	4·91	255
80	Lermont Volunteer	8,658	15	4,077	211	3	5,108	283	3	5,794	353	1	4,954	249	18	24	4,315	5·40	233
81	Jersey Lea Golden Duke	13,831	20	4,793	267	14	5,455	316	5	5,903	315	14	6,016	324	27	63	5,192	5·60	291
82	Masterpiece Yerribee of Bruceville	3,292	7	5,299	277	5	5,728	305	4	6,428	344	8	7,793	426	17	25	6,491	5·28	343
83	Maurfield Larkspurs Gift	9,632	9	6,195	330	5	7,579	377	1	6,942	349	8	8,192	405	16	23	7.207	5·06	365
84	Mornmoot Clementines Valour	12,092	7	6,525	312	4	5,977	288	3	6,913	347	2	9,373	488	15	16	6,710	4·89	328
85	Navua Ladoras Ruler	10,249	6	5,880	349	4	6,472	373	6	5,687	363	4	5,975	335	18	20	6,097	5·95	363
86	Oxford Ajax	11,553	7	6,243	312	3	6,524	351	..	..	..	1	6,742	401	10	11	6,213	5·17	321
87	Oxford Aster's Lad	8,129	5	4,927	301	5	7,537	354	2	6,496	314	7	7,275	360	18	19	6,612	5·13	339

TABLE 12—*continued*.

AVERAGE PRODUCTION OF DAUGHTERS OF INDIVIDUAL SIRES—*continued*.

Reference No.	Sire.	Herd Book No.	Average Production of Daughters in Various Age Groups.												Average of all Recorded Daughters.				
			2 Year Old.			3 Year Old.			4 Year Old.			Mature.							
			No.	Milk.	Butter-fat.	No.	Milk.	Butter-fat.	No.	Milk.	Butter-fat.	No.	Milk.	Butter-fat.	No.	No. Lact	Milk.	Test.	Butter-fat.
				Lb.	Lb.		Lb.	Lb.		Lb.	Lb.		Lb.	Lb.			Lb.	%	Lb.
	JERSEY—*continued*.																		
88	Oxford Brown Victory	6,162	8	5,650	290	2	5,022	292	2	5,495	339	3	4,740	252	12	16	5,217	5·33	278
89	Oxford Daffodil's Victor	11,016	10	6,188	347	4	8,141	467	2	8,539	459	5	6,386	399	20	21	6,668	5·74	383
90	Oxford Fawn's Noble	14,530	15	5,775	321	4	6,633	375	..	..	..	..	..	..	16	19	5,989	5·54	332
91	Oxford Fawn's Victor	12,605	10	5,620	297	2	4,760	246	..	..	..	1	6,669	364	13	15	5,568	5·28	294
92	Oxford Noble Peer	9,124	8	4,912	282	4	5,709	330	1	7,321	436	1	6,834	367	11	14	5,265	5·73	302
93	Oxford Peer	7,361	16	5,717	313	4	6,167	332	..	..	..	1	7,315	385	19	22	5,829	5·51	321
94	Oxford Pixie's Victor..	10,837	16	5,422	287	3	5,941	302	3	6,637	336	2	6,625	312	19	25	5,542	5·20	288
95	Oxford Royal Lad	8,001	27	5,888	315	7	6,980	369	7	7,341	389	2	7,209	338	37	43	6,086	5·27	321
96	Retford Earl Victor	3,655	11	7,349	380	3	6,931	392	6	7,261	374	8	8,101	392	18	29	7,205	5·14	370
97	Retford King's Thorn	5,115	12	6,170	325	5	7,286	411	3	8,319	464	8	8,168	449	26	28	7,246	5·44	394
98	Retford May's Victor..	5,286	8	6,141	336	2	6,051	345	2	8,373	503	6	7,745	411	12	21	6,682	5·31	355
99	Retford Royal Atavist	7,066 (J.S.B.A.)	28	4,607	254	2	5,377	307	1	10,115	590	9	8,927	492	37	41	5,614	5·54	311
100	Samares Cute Prince 3rd	8,876	8	6,423	345	3	8,615	427	3	8,134	416	3	7,657	416	13	17	7,023	5·24	368
101	Selseys Royal Standard	12,093	3	6,117	332	7	6,040	312	2	5,579	291	3	7,032	329	12	15	6,195	5·18	321
102	Selseys Samares Hallmark	11,722	26	5,419	288	2	6,320	363	1	7,462	404	2	6,298	364	26	32	5,423	5·38	292
103	Trecarne Butter Queens Officer	10,218	9	4,263	239	2	5,377	311	2	4,852	270	4	5,307	298	10	19	4,508	5·61	253
104	Trecarne Golden King 2nd	11,233	13	5,422	335	4	6,641	404	1	6,027	374	1	7,699	474	16	21	5,723	6·13	351
105	Trecarne Renown 2nd	5,546	23	4,947	264	9	6,639	357	4	6,546	343	2	6,775	360	27	40	5,325	5·46	291
106	Trecarne Royal Officer	12,999	17	3,770	212	2	4,772	276	1	6,528	315	..	..	..	18	21	3,925	5·53	217
107	Trecarne Some Duke	11,850	19	4,989	268	12	5,498	298	8	5,818	301	7	5,905	327	29	49	5,393	5·38	290
108	Trecarne Victor 4th	11,492	24	4,930	252	11	6,073	307	8	6,256	328	4	6,916	356	28	52	5,295	5·08	269
109	Trinity Ambassador	2,834	15	5,793	325	8	7,169	428	5	6,546	367	6	6,903	375	24	38	6,058	5·56	337
110	Trinity Crowing Effort (imp.)	12,311	15	5,399	273	6	7,739	411	5	8,452	432	6	8,460	431	23	34	6,593	5·06	334
111	Trinity Cute Commodore	11,101	7	7,436	365	6	7,766	390	3	8,013	394	2	6,881	347	17	18	7,609	4·95	377
112	Trinity Graceful Duke	14,574	16	4,745	258	2	5,319	308	..	..	..	..	..	..	16	20	4,745	6·07	288
113	Trinity Governors Hope	5,730	42	5,684	292	19	7,537	382	6	7,357	398	17	8,382	425	55	89	6,345	5·12	325
114	Trinity Golden Royal	10,760	11	5,126	274	7	6,084	335	2	6,134	320	3	6,818	380	18	24	5,699	5·46	311
115	Trinity Mighty Prince	13,674	8	5,551	310	1	6,256	330	1	7,627	364	..	..	..	10	10	5,829	5·32	310
116	Trinity National Victory	12,309	7	6,113	305	4	7,242	372	1	8,263	390	1	7,417	347	13	13	6,726	4·93	335
117	Trinity Noble Effort 2nd	13,323	21	4,664	250	5	5,539	306	3	6,033	367	..	..	..	22	30	4,822	5·41	261
118	Trinity Popcorn 2nd Pioneer	6,952	4	5,814	299	1	5,503	343	4	5,564	280	2	6,765	347	10	11	5,770	5·16	298
119	Trinity Royal Prince	10,756	6	5,251	259	4	5,999	304	1	5,172	263	1	6,567	349	12	12	5,603	5·03	282
120	Trinity Royal Sovereign	8,180	7	5,587	276	2	6,238	299	1	4,073	238	5	6,613	333	15	15	5,915	5·00	296
121	Trinity Some Officer	6,798	7	5,428	314	9	6,666	390	8	7,443	439	12	6,625	379	21	46	6,403	5·79	371
122	Vinchelez Golden Victory (imp.)	4,923	14	4,395	256	6	5,025	304	..	..	..	4	5,311	283	18	26	4,747	5·69	270
123	Westbrook Asters Lad 39th	11,654	4	4,077	216	6	4,891	250	..	..	..	..	..	..	10	10	4,565	5·17	236
124	Westbrook Asters Lad 44th	11,865	1	2,396	98	..	..	..	4	4,288	212	9	4,217	217	14	14	4,107	5·04	207
125	Wheatlands Jester (imp.)	6,950 (J.S.B.A.)	2	5,544	268	3	7,364	387	1	10,379	615	7	7,526	411	11	13	7,077	5·23	374
126	Woodside Golden Volunteer	6,366	58	5,118	269	16	6,335	337	6	6,346	344	9	7,183	383	66	99	5,407	5·25	284
127	Woodview Officer	14,025	12	3,765	205	1	4,496	234	..	..	..	..	..	..	12	13	3,830	5·46	209

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